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ENGLISH BEETLES AND THEIR RELATIVES IN THE TROPICS.

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(*With a Coloured Plate.*)

During the winter months, when the more generally attractive classes of insects are but rarely met with, the entomologist may still seek with success for several kinds of beetles, which may be found under large loose stones, or beneath flakes of dead bark, or in the shelter of matted clumps of moss. Sport, however, is not so abundant, nor the weather for pursuing it so pleasant as in summer; insomuch, that the collector is sometimes forced upon the study of dried specimens in cabinets, rather than the living specimens in their native haunts. In this way I have been driven from the open fields to the task of comparing, in various collections, some of our best known British beetles with specimens of their exotic relatives; speculating on the possible influences of climate, or immediately surrounding conditions, on their development and general aspect. I have found the occupation both instructive and amusing, as are all studies connected with entomology. No form of animal life has in fact attracted the attention of naturalists more constantly, and proved more generally instructive, than that of insects. Among these the beetle tribe especially were noticed by the ancients at a very early period, from two very opposite points of view—superstition and philosophy. With the sacerdotal naturalists of Egypt, who had carefully observed the habits and transformations of the beetle, that insect became a symbol of the principle of metempsychosis, and other theological dogmas; while with the Greeks, in the hands of Aristotle, it became an example of one of the acutest methods of classification, founded on anatomical structure, that science ever devised. Finding that the whole of the beetle family were furnished with wings protected by a sheath-like covering, he compounded of the word χολεος, a scabbard or case, and

πτερον, a wing—a term which, latinized as Coleoptera, is still applied to the entomological order comprising the beetles. It is true that some of the insects included by Aristotle in his great family of Coleoptera, have been removed by modern science to other natural orders; but the great distinctive feature, as a class definition, and also the very name by which the father of natural history distinguished it, are both retained in the natural philosophy of modern times, no better character or name having been found for the order of insects to which they were originally applied by the Macedonian entomologist of two-and-twenty centuries ago. More than one among our modern naturalists have sought to alter the venerable term invented by the founder of their science, but none of their suggestions have been permanently adopted. It is indeed well that they have not, for although embodying some advantages, we should have been the losers by the change of that fine aroma of antiquity that hangs about the venerable term invented by the Stagyrite. Fabricius suggested the term *Eleutherata*, and Clairville endeavoured to establish his own title, *Elytroptera*, for the beetle tribe, either of which terms might have served their purpose with great propriety; but the good old name, Coleoptera, was destined to hold its ground, and it is now too well established to fear erasure by any modern pen, however innovative or daring.

Speaking of Aristotle reminds me of a curious error of the press which occurs in M. Guerin de Menneville's preface to the *Revue Zoologique*, in which, speaking of the vast range of the works of Cuvier, he calls him, "cet *Arioste* des temps moderne."* The passage thus becoming one calculated to astonish, not a little, the great French naturalist, who certainly never expected, even accidentally, to be compared to the author of the *Orlando Furioso*.

Our native beetles are not so conspicuous by their forms, or so finely coloured as those which attracted the attention of Aristotle in the fine climate of Greece, but there are yet many among them that are not without considerable beauty; and indeed our native species of Cicindelidæ are not surpassed by their near relatives in the more southern parts of Europe, and are scarcely inferior in beauty to some of their intertropical relatives with which I am about to compare them. The commonest, and at the same time the prettiest of the British species of Cicindela, is the well known *C. campestris* (No. 6), the elegant and active little green beetle, with yellowish spots, that may be found in sandy districts on any fine sunny day of early spring. This species has long been known to collectors as the tiger beetle; as some say from its spots and stripes, but as

* Meaning of course *Aristote*, the abbreviated form of the name of Aristotle commonly used by the French.

others assert from its carnivorous nature, preying as it does upon other insects, and occasionally even upon its own species. These beetles were also termed by our old collectors, "sparklers," from their brilliant aspect when the sun shines on them, especially during the short but rapid flight which they indulge in during sunshine, especially when alarmed, making a humming noise like bees. M. Desmarets was the first to observe the method pursued by the larvæ of tiger beetles for capturing their prey. They construct, as he informs us, a narrow tunnel or pit of the depth of about eight or ten inches in perpendicular depth, sometimes more than a foot, according to the nature of the earth in which it is formed, which is generally sand. When complete, they climb to the mouth of the tunnel, making their broad flat head, which they cover with sand, form a kind of trap-door to this treacherous oubliette. They sustain themselves in the desired position by means of two hook-like appendages, plainly shown in the annexed representation of this ingenious and predatory larva, till a small insect passes over the living trap-door concealed by a treacherous layer of sand, when the larva immediately allows itself to drop to the bottom of the burrow, followed of course by the tumbling victim, who is speedily devoured. If the insect passing over the trap is too large to fall readily into the tunnel, it is seized as it passes, and dragged forcibly down to its destruction in the dark pitfall. These treacherous Cicindelæ are in truth very garotters among the insect races—insect ticket-of-leave-men of the very worst class. Nothing is known of the larvæ of exotic Cicindelæ, but Labreille considers that in all probability they resemble, both in form and habits, those of the European species. The female of *Cicindela campestris* may be distinguished from the male by the presence of two additional buff spots. *C. Germanica* is another British species, and also *C. hybrida*, of which last there is a specimen in the collection of the Linnean Society, with the name in the handwriting of Linnæus himself.

Larva of *Cicindela campestris.*

In the climates of the New World many Cicindelæ are found in the vast forests. Some of these appear not to be predatory, but live on the bark of trees, while others reside among the foliage, flying rapidly from leaf to leaf, and darting with great dexterity upon their prey. In 1839 it was calculated by Baron Dejean that 250 species of Cicindelidæ were known, the greater number of the species being exotic or extra European. The exotic species generally resemble our own, in being commonly of a green bronzed colour, elegantly variegated with streaks and spots of white, buff, orange, or red on the elytra or wing-sheaths, but

there are many variations from this general character. *Cicindela lepida*, found in the Deccan, is black, with an orange mark on the back like a saddle; and *C. flavi punctata*, also found in the East Indies, is of a deep blue, nearly black, with four orange spots. M. Chevrolat describes several Mexican species, among which *C. curvata* burrows in moist sand, when the sun is obscured, or the wind cold. The natives macerate this species in water or spirits to procure a liquor possessing medicinal qualities, which are highly valued. The pretty *C. 6-punctata* and *C. 20-punctata* are described by Westerman as being found on young rice plants in the West Indies, and these, notwithstanding the great difference of climate and surrounding circumstances, do not very much differ from our native species, either in size or the general tone of the colouring; while in Cochin China, where the temperature is moderate, and much nearer to our own, a marked difference occurs in the long-legged species, very distinct in character, which has been separated from the genus Cicindelæ by Laporte, under the generic name Odontocheila. In Calcutta a species is common which materially differs in habits from all the previously-described species, which love the brightest daylight, and seek some retreat as soon as a cloud obscures the sun, while the species alluded to flies by night only, being attracted by a lamp, like moths, and entering rooms when candles are lighted, and even the cabins of ships at anchor in the Hoogly.

The larger of the Cicindelæ belong to the genus *Manticora*, among which there are species near two inches long, chiefly found on the arid plains of Africa. These are entirely black, and differ essentially from our kinds in having no available wings, the elytra, or external wing-cases, being joined down the middle of the back, instead of being divided in the usual manner. Some of the exotic species have available wings without using them; and M. Lacordaire says that *Megacephala sepulchralis*, a South American species, is one of this kind, never flying, but running from danger with great swiftness through the long rank grass in sandy places in the Brazils. This species, like the English *C. campestris*, emits a pleasant, rose-like odour. Another Brazilian species often takes possession of the deserted burrows of the Copredæ, the entrance of which it defends with great pertinacity, but feeling itself overpowered, it retreats to the bottom and will not appear again. Its pugnacious disposition, however, renders its capture easy. The collector has only to insert a long straw to the bottom of the burrow, when it will immediately be seized by the insect, and refusing to let go its hold, may thus be drawn out and captured. Among all the exotic Cicindelidæ, whether belonging to temperate or intertropical climates, none mate-

rially surpass in elegance of form or colour our own *C. campestris*, except the exquisitely beautiful Chinese species, *C. Chinensis*, one of the most common insects of the tea-growing districts, and which is often found in the chests of tea exported to this country. It may be observed, as a curious fact, that, while none of the tropical species materially surpass our own either in form or colour, this remarkably handsome insect, inhabiting a climate very similar in general temperature to our own, so far surpasses both in size and beauty our pretty *Cicindela campestris*. Exquisitely clouded markings of deep purple, rich in tone and texture as tinted velvet, form the most conspicuous feature in the colouring of this insect; these masses of purple shading off at the edges into the rich apple green which forms the general ground; the green becoming in places nearly a silvery azure. This green ground is again varied by conspicuous marks of delicate buff; the central ridges of the elytra being also of a buff tone, with a metallic gloss of gold. The richness, and at the same time intricate delicacy of this colouring is such as cannot be perfectly imitated in a drawing, yet the representation in the plate (No. 7) will serve to give a fair general idea of the beauty of this finest of the exotic Cicindelidæ.

The next class of English beetles that I found the means of comparing with their exotic relatives, was a section of the extensive order Curculionidæ. None of the native species of these pretty little beetles—with their long neck and head, of almost trunk-like form, which gives them the air of miniature elephants, and in consequence of which they have been named *κυρκυλιω* (neck or throat)—are remarkable either for size or colour. Most of the tribe are herbivorous, and among the best known of the British species is the corn weevil, *Calandra granaria*, which feeds on grain. Then there is the well-known *Balaninus nucum*, the larva of which is found in ripe nuts, and by means of which the forms of the larvæ of all the kinds may be approximately known. The perfect insect drills a hole with its long trunk in the young nut, and the larva when full grown eats a hole through the hard shell after it has devoured the kernel. Falling to the ground, it buries itself to undergo its transformation, which is completed in the following spring. The Curculionidæ have not the gift of speed like the Cicindelæ, but, when danger approaches, fall from the spray on which they are feeding, and remain perfectly still, with the legs collapsed, as though dead. Those of the genus Otiorhynchus, like several others, feed on growing roots, while the species of Scolytus and others feed on the young wood of forest trees, beneath the bark.

Though exceedingly numerous, our native species are all

small and inconspicuous, while the exotic genera of the tribe contain many of the most splendid insects yet known, among which may be cited, as a well-known example, the celebrated Diamond beetle of Brazil. The English Curculio, which I have taken as being a fair general representative of our native kinds, is *Otiorhynchus ligustri*, the common Curculio of the Privet, represented at No. 1. This insect, of a dull olive brown colour, with the tuberculations of the elytra rather paler, has certainly no pretensions to beauty except, perhaps, in the general elegance of its form. But directly we approach the tropics for the purpose of examining his foreign relatives, we find not only that many of the species assume a very superior growth, more than quadrupling the size of our native kinds, but that their splendour of colour often equals, if it does not surpass that of any other class in the whole insect world.

The most remarkable contrast among exotic species, both in size and beauty, to our native Curculios, occurs perhaps in the magnificent *Eupholus Schönherri*, discovered in the Island of Cœlebes, by the officers of "La Coquille," the French ship of discovery that circumnavigated the world in 1833. It was first taken at a little seaport of Cœlebes, called Dory, one of the hottest parts of that intertropical region, and which, in the general account of the voyage, is described as swarming with resplendent insects of various kinds. The first specimen of this till then unknown relative of the Curculios, which was captured on that occasion, and which eventually found its way to the collection of M. Chevrolat, was seen and described by M. Guerin for the zoological section of the voyage of "La Coquille," when he made it the type of a new genus, which he called *Eupholus*, a term adopted by Boisduval when he described other allied species discovered in the voyage of the "Astrolabe." The name appears to be composed of the Greek words, $\epsilon\upsilon$, fair, and $\phi o\lambda\iota\varsigma$, a scale, in allusion to the powdery bloom similar to the minute scales of the wings of butterflies, with which its elytræ are covered. The representation in the plate (No. 5) can give but a faint idea of this subdued metallic kind of lustrous bloom, but the general distribution of colour is well represented. M. Guerin describes the ground colour as being of a lovely glaucous green, slightly metallic, the corslet being brilliant azure, passing off imperceptibly to a delicate green at the edges; the wing-cases having transverse stripes of deep velvety black, and the space comprised between the first and second pair of stripes, and between the third and fourth, being a fine light blue. The specimen in the British Museum, recently sent from Cœlebes by our enterprising collector, Mr. Wallis, does not entirely agree in colour with M. Guerin's description. This may be accounted for by the colours having changed or faded

in dead specimens, or from the specimen in M. Chevrolat's collection, or the one in the Museum, being a variety. The colours of the large specimen in the British Museum, and also of several smaller specimens, are as follows:—The head, ochreous green, with deep brown stripe; the corslet, a brilliant lilac, becoming pink in high light, and changing to green towards the edges; the elytræ are of a bluer lilac, and have five transverse bars of black, the spaces between the first and second bar and the third and fourth being a greenish white, which contrasts very delicately with the blue lilac of the other portions of the wing-cases; the legs are brilliant metallic green, with the exception of the joints, which are of a rich purplish azure and very brilliant; the antennæ are of a delicate cinereous green, with brown tips. I believe the largest specimen in the Museum is marked as a variety; but as there are several specimens exactly like it, except in size, our specimens may prove to be distinct species.

Several other species of the new genus Eupholus have been discovered since *E. Schönherii;* some at the same port, Dory, and other parts of New Guinea; one in the Island of Amboyna, and one or more in the Arrow Isles, during the subsequent voyages of discovery of the "Astrolabe" and the "Zelee." M. Guerin describes in detail the six additional species of his new genus Eupholus in the *Revue Zoologique,* for 1841, all magnificent insects, with green and blue elytra, finely striped with black bands; but they are all of inferior size and beauty to the original type of the genus, which in its turn is inferior to the variety or new species in the British Museum (No. 5 in the plate).

Another section of exotic Curculionidæ, the species of which form a striking contrast with our native kinds, on account of their great brilliancy, is principally founded on the beautiful insects of this class from the Philippine Islands, which were procured by Mr. Cuming a few years ago, all of them till then unknown to European naturalists. For the classification of these insects, M. Germar first established the genus *Pachyrhynchus,* formed of the Greek word παχος, thick, and ρυγχος, a beak or bill, from the thick elongation of the head, as distinct in character from that of the European *Otiorhynchus.* The new name was first given to a single species which was at that time commonly received from Manilla, being the only species then known. MM. Eydoux and Souleyet met with and described another species from the same place in 1839. But these were nothing to the wonderful collection of this glittering Curculian group brought to Europe by Mr. Cuming in 1840. Mr. Cuming, an English merchant, was residing at Lima, and trading from thence to the Philippines, when he became greatly

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interested in the formation of a collection of marine shells, for which the shores of those islands have long been celebrated. Sailors whom he engaged as his agents to purchase specimens from the natives, brought back a few insects as well as shells, and these were of a character to make our collector turn his attention in that direction, leading eventually to the discovery of those brilliant specimens which so much astonished the entomological world of the year 1840 with their novelty and splendour. On his arrival in Europe Mr. Cuming disposed of some of his new Philippine insects to M. Paryudhaki, and these were described by M. Chevrolat, in 1841, in the *Revue Zoologique* for that year; while M. Guerin, in 1842, described a species from a new locality, the Salomon isles, making the fourteenth of this new and magnificent genus. Other species followed, which were described by M. Guerin, all, with the one exception above named, belonging to the Philippines.

Those purchased of Mr. Cuming by the trustees of the British Museum were described by Mr. Waterhouse, bringing up the number of species to near fifty, and it is from among those last that I have made the selection represented in the plate, namely, *P. gemmatus* (2), *P. speciosus* (3), *P. reticulatus* (4). Of these *P. gemmatus* is by far the largest and most splendid. But its splendours are of that minute as well as metallic character which cannot be exhibited in a drawing unless greatly magnified, and even then the glitter of the metallic effects would remain unrepresented. The ground colour is a rich crimson maroon, with a golden gloss in the high lights. But the large spots, which have the appearance of being inlaid with a variety of gems, form the chief feature. In the centre of each of these gemmed circlets the inlaid colours appear to be composed of minute triangles of turquoise and emeralds, with granules of silver between, while towards the margin the emerald disappears, and the mixture is blue and yellow, with a larger admixture of the granules of silver, the whole surface being so brilliantly polished that each minute gem is distinctly seen. It is, however, only in the microscope that all the magnificence of the details can be fully appreciated, though sufficiently splendid even to the unassisted eye. The pretty *P. reticulatus* and *P. speciosus*, Nos. 3 and 4, are also beautiful insects, from the excessive clearness of their markings, and the high polish of their entire surface, but they fall far short of the splendour of our *gemmatus*, or even of the *P. gemmans* of the French collection.

Our native *Carabidæ* are another class which I compared with their foreign relatives. It is in this division that some of the largest and most robust of the beetle tribe are found, and I made many comparisons bearing on the influence of climate,

etc. I have however, at present, only space to allude to the British and Continental specimens figured in the plate, Nos. 8 and 9. The native species, *Carabus intricatus*, which has received its specific name from the intricacy of the tuberculations by which the surface of the elytræ are variegated, was so rare a very few years ago that some considered it not truly indigenous; but it has since been captured in some numbers, in consequence of the discovery that moths were attracted by melted sugar brushed on the bark of trees at night, which happened to prove equally attractive to our night-roaming beetle, *Carabus intricatus*, and numbers were taken by the newly discovered bait. The "golden beetle," *Carabus auratus*, belongs to the same genus, and is perhaps the handsomest of the native *Carabi*. This species, like many of the *Carabi*, is carnivorous, and is called by the French *Le Jardinier*, as the enemy of cockchafers. It attacks the female when in the act of depositing her eggs, and so destroys at once a whole brood of those destructive insects. The *Carabidæ*, which are *carnivorous*, thus feed on other beetles which are *herbaceous* feeders, just as carnivorous quadrupeds prey upon those that are herbivorous. The golden beetle is a very handsome insect, but with all his brilliancy he is not comparable to his foreign cousin, *Carabus Hispanus*. This last species is not indebted to a tropical sun for his superior brilliancy; for, on the contrary, his habitat is on the borders of eternal snow, in the Alpine regions of Central Europe. The true genus *Carabus* in fact disappears on approaching the tropics, as it does also in more northern latitudes, while the allied genus *Calosoma* is distributed all over Europe and even South Wales; and on some future occasion I may endeavour to trace the change of aspect of this widely distributed insect in different climates. On the present occasion I have only space to refer very briefly to *Carabus Hispanus*, as a contrast to our native *Carabi*. In the first place he is nearly twice the size; but the size is his least attraction. It is in his brilliant metallic colours that his great beauty chiefly consists. The head and corslet are of the richest metallic purple, while the elytræ, or wing-cases, are of the most dazzling olive gold, so solidly brilliant that chased and burnished metal itself could not surpass it. In the lights this golden glitter becomes a yellow, while in the shades it assumes a ruddy tone, getting richly crimson in a narrow channel round the edges. *Carabus aurofasciata* is another splendid exotic species—from India; not, however, from the tropical plains, but from the mountainous regions of the north. It is of a deep bronze tone of colour, with a broad diagonal cross of light brilliant gold colour on the back, extending across both the elytræ.

It will have been observed that a widely distributed family of insects do not invariably assume strikingly different aspects by the influence of climate. It will also have been seen that it is not always beneath the sun of the tropics that increased size and increased brilliancy of colour are found. The differences of aspect, indeed, in so far as we can estimate them by reference to climate, appear very capricious. It may, however, be assumed as the more general rule, that the most splendid and gigantic insects of intertropical regions present characteristics very distinct from those of insects belonging to the temperate zones, and therefore, in most cases, comparison cannot be made with reference to changes brought about by influence of climate; each region appearing to have a strongly marked insect family peculiarly its own, no members of which (with a certain allowance for exceptions) appear in their really characteristic forms beyond the limits of certain geographical lines.

OBJECTS ILLUSTRATIVE OF ROMAN PROFESSIONS AND TRADES, DISCOVERED IN THE EXCAVATIONS AT WROXETER.

BY THOMAS WRIGHT, F.S.A.

In a former paper in the Intellectual Observer I gave an account of the discoveries made, during the autumn of 1861, in excavations in a field which occupied part of the site of the cemetery of the Roman city of Uriconium, at Wroxeter, near Shrewsbury. Since that time, a field adjoining, which occupies a portion of the same cemetery, has been the scene of excavations, and, although but partially examined, it has been no less productive than the other in interesting discoveries. Among the objects brought to light on this occasion are a rather considerable number of sepulchral urns and other vessels in earthenware and glass, with various objects of a more miscellaneous character, among which one of the most remarkable is a Roman surgeon's lancet, an article I believe to be unique in Roman antiquities, certainly among those found in Britain. The discovery of such an instrument, under these circumstances, rather naturally draws our attention to the more general subject of the professions and trades practised in the towns of Britain during the Roman period—a subject of the more importance because they were probably the origin of the professions and trades of our mediæval period, and through them, in some measure, of those of modern times. What were the

trades and professions exercised in the great Roman city of Uriconium, and under what form were they carried on?

It is evident that in the circumstances generally attending the Roman remains found in our island, discoveries such as I have just alluded to must be extremely rare, and it is only in the almost undisturbed ruins of a great city, like Uriconium, that we can hope to meet with anything which is authentic to our purpose, that is, which belongs to professional or industrial occupations exercised on the spot. We meet with abundance of manufactured articles, but there are no circumstances connected with them to enable us to say where, or by whom, they were manufactured. Although the buildings which we have been chiefly exploring within the ancient town of Uriconium were of a public character, and not likely to yield us much information of this sort, yet enough has been found, even in the very small space yet excavated, to show that we may hope, as we proceed further, to make discoveries which will throw great light on this subject, and, indeed, on the whole internal economy of a great Roman town in Britain, in the beginning of the fifth century. Meanwhile it will, perhaps, not be uninteresting if I give here a brief and collective account of the objects already discovered, which belong to professions or industrial callings exercised in ancient Uriconium. And first let us speak of the lancet just mentioned.

We seem to know but little of the surgical practice, or of the use of the lancet, among the Romans, but we learn from Celsus that the name by which this instrument was known was *scalpellus*, or, sometimes, *scalper* and *scalprum*, words which mean simply a small cutting instrument; while, at a rather later period, Isidore of Seville gives it its Greek name *phlebotomum* (φλεβότομον), which expresses its more especial use in letting blood by making an incision in the vein. The *scalpellus*, or lancet, represented in the cut annexed, was found in the recent excavations in the cemetery of Uriconium, and had, no doubt, been deposited in the grave of the surgeon who had used it; but it is uncertain whether it was placed in his sepulchral urn with his ashes, or beside it, for the latter was broken, and its contents scattered about before they were noticed by the workman. Along with the lancet were found a small lock and some beads, with other remains, from which it appeared that these, and probably the lancet also, had been inclosed in a box or casket, no doubt of wood, which, of course, had perished, but it had been considered of sufficient importance to be locked. The handle of the lancet, which is in the form of a narrow oval loop, is made of bronze, and has at the far end from the blade a small projection, from which something has been broken, probably a knob. A small disc forms a sort of guard to the

blade, which latter is of steel, and still so sharp that a very distinguished surgeon of modern Shrewsbury tells me that he thinks he could almost perform an operation with it in its present state. The lancet has been contained in a wooden case or sheath, lined internally with leather; and the more considerable fragments of the wood, which is rather coarsely grained, and leather lining of this sheath, are represented in our cut.

ROMAN LANCET AND FRAGMENTS OF ITS CASE.

Thus it is evident that there were in Uriconium surgeons who, whatever may have been their skill in operating, had, at least, perfectly good instruments for the purpose. It is not improbable that, as in the middle ages, so in the Roman towns, the practice of the surgeon, or chirurgus (χειρουργὸς, the man who operated with his hand), was entirely distinct from that of the physician, or *medicus*. We have, also, in the Wroxeter Museum at Shrewsbury, a very curious memorial of the medical

practice in ancient Uriconium. It is one of what are usually called Roman oculists' stamps, consisting of an inscription engraved on a neatly formed round slab of whitish stone, rather more than an inch in diameter, intended, of course, for impressing the names of the medicine and its maker on the pot, box, or parcel containing the former. Our inscription may be read as follows:—

TIB CL M	*Tiberii Claudii medici*
DIALIBA	dialiba*num*
AD·OM	ad om
NE·VIT	ne vit*ium*
O EXO	*oculorum* ex ovo

It may be translated, "The dialibanum of Tiberius Claudius, the physician, for all complaints of the eyes, to be used with egg." This object belongs to a class of Roman antiquities which are by no means uncommon. More than half a dozen have been found in Britain, and a greater number have been met with in Gaul and Germany. Of those found in England, the localities of the discovery of five only are known, and, curiously enough, these are all on the western side of England, on the sites of the towns of Uriconium (Wroxeter), Magna (Kenchester), Glevum (Gloucester), Corinium (Cirencester), and Aquæ Solis (Bath). It is also remarkable that all these stamps yet known are for ointments and other medicines for diseases of the eyes; and we seem thus justified in assuming that diseases of the eyes were very prevalent among the population of Western Europe under the Roman empire. We have not a sufficient knowledge of the sanitary condition of society at that time to enable us to state why this was the case. Most of these stamps are engraved on small parallelograms of stone, and occupy the edges, so that there are from two to four different inscriptions, for so many different medicines made by the same physician, all for eye-diseases, and all expressed in much the same formula. Thus, the example found in our nearest neighbouring Roman town, where they occurred, Kenchester, has four inscriptions, and that found at Cirencester two. One of the inscriptions of the Cirencester stamp may be given as an example. It is in two lines, and may be read,—

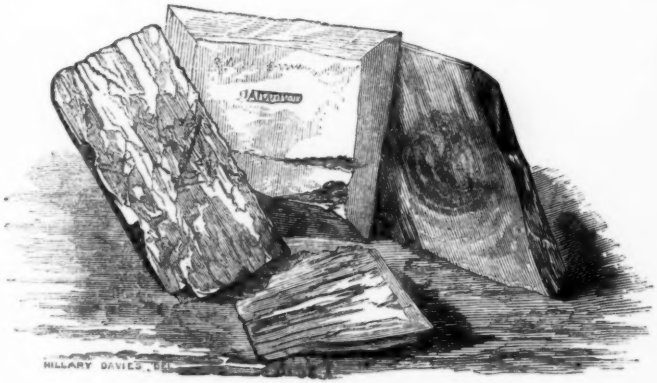
MINERVALISDIALEB	Minervalis dialeb
ANVMADIMPETLIPEXOV	anum ad impet*um* lipp*itudinis*, ex ovo.

"The dialebanum of Minervalis against lippitudo, to be used with egg." Of all these stamps yet found, no two bear the same name, from which we are justified in considering that the names are those of the local practitioners to whom each belonged. The specific of Minervalis, as it will be seen, was a similar ointment to that sold by Tiberius Claudius, the physician of Uriconium. The dialebanum was a well-known ointment for

the eyes, made originally of a vegetable substance, said to have been procured in its greatest purity from Arabia; but no doubt these local doctors used other substances in its place, and probably each pretended to greater perfection than his neighbours. In the Cirencester inscription, as in that found at Wroxeter, it is directed to be used *ex ovo*, or to be applied beaten up with egg. It has been supposed that these stamps belonged to oculists only, but the presence of the term *medicus* can leave no doubt that the individual to whom our stamp belonged, Tiberius Claudius, was a general physician of Uriconium.

Neither of these curious monuments of the civilization of a far-gone past, the lancet or the medicine stamp, give us any room even for a conjecture as to the part of the city of Uriconium in which the surgeon or the physician dwelt, the manner in which he exercised his profession, the social position which he held, or even the exact period at which he lived; but this is not quite the case with the objects to which the attention of our readers is next called, and which belong to a profession of an entirely different character. It may be necessary, in explanation of this discovery, to state briefly that the principal buildings we have been laying open at Wroxeter consist of the Basilica or municipal hall, an extensive edifice running east and west, and opening in the latter direction upon the forum; the public baths, attached to the basilica on its southern side; and a long block of buildings between the baths and the forum. Among the last-mentioned buildings, and not far from the same spot, were found, at different times, three small rectangular slabs of a whitish stone, apparently steatite or soap-stone, which had been carefully smoothed, the one side presenting a perfectly level surface, but the other bevelled off at the edges. They are nearly of the same size, about two inches and a-half broad by two inches and three-quarters long, and not quite half an inch thick. A very slight examination was enough to show that these were painters' pallettes. They are represented in our cut, in which it will be seen that the one to the right is very much worn in the middle of the upper or unbevelled side by the action of the painter rubbing his colours, and, indeed, traces of the colours may still be perceived. This pallette had been accidentally broken, and the fracture as here shown will give a better notion of the form of the pallette, and of the character of the wearing, than any description. We have every reason to believe, from the locality in which these objects were found, that there was a painter's shop, or studio, somewhere between the baths and the forum, so that the fine arts, perhaps, flourished in Uriconium. But one of these pallettes furnishes us with another fact of some interest connected with this subject. On

the back of this pallette, which is turned towards us in the engraving, and which has been less used than the one just described, we find, among several scratches made intentionally with a sharp instrument, a man's name, rudely but minutely written in a small tablet, evidently an imitation of the forms in which the potters' names are stamped on the red Samian ware. No similar inscription is found on the other pallettes, and, from the manner in which it has been executed, we are fairly justified in supposing that it is the name, not of the maker of the pallettes, but of the possessor of this particular example, and probably of the others also. From the careless manner in which this inscription is written, it is not very easy to decipher, but it appears to be DICINIVMA, which may be read as Dicinivi manu, by the hand of Dicinivus. Thus we

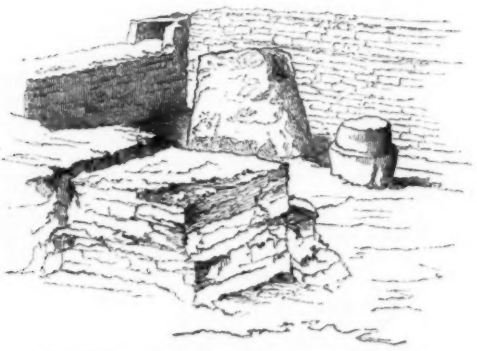


ROMAN PAINTERS' PALLETTES, FROM URICONIUM.

have, in all probability, the name of a professional artist of Uriconium, who flourished at the time when the town was destroyed, and which, certainly not Roman, would apparently show him to be either a Gaul or a German. All this is extremely important in its relation to the history of art, one of the most valuable measures of social refinement at this very interesting period. Our knowledge of the forms of the practice of art among the Romans is in some respects defective, although they appear in general to have resembled very closely those in use at the present day. We do not even know any distinctive name for the pallette, except the word *assula*, which means simply, like pallette itself, a thin slice or chip of stone, or other material. Wall pictures have been met with in Pompeii, in which the painter is represented at his work. In

one of these, which is a burlesque or caricature, the painter, seated before a very modern-looking easel, has a tablet of stone, supported on four legs, as a large pallette, on which he can spread a number of colours at the same time; but in another painting, which represents a female artist making a drawing of a statue of the bearded Bacchus, the lady holds in her left hand a real pallette, only differing from those I have just described in being oval instead of rectangular.

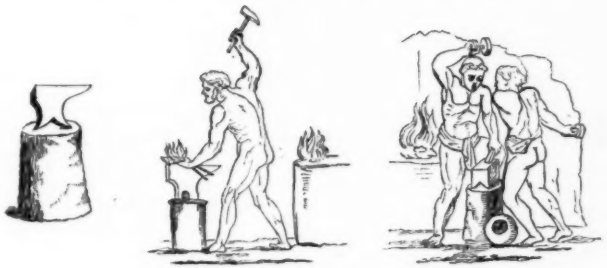
We have thus already discovered interesting memorials of the existence, in Uriconium, of an important branch of science, and of an equally important art—the healing science in its two branches of medicine and surgery, and painting; and we have brought to light the names of a physician and painter, who lived, and no doubt flourished, in the Roman city. We must now descend to a profession which may perhaps be described



INTERIOR OF ENAMELLER'S SHOP IN URICONIUM.

as of a less elevated character, though I am not sure that it also did not belong to a high degree of art. Moreover, it is a case in which we can identify the spot on which the art was practised. We opened a large, square room, of about thirty-eight feet by forty, a little to the south of the Basilica, and adjoining westward to the forum, which proved to be the workshop of an artificer in metals. Towards the north-eastern corner of this room stood a pile in the form of a sugar-loaf, about six feet high, built very roughly of clay, mixed with stones and other unprepared materials, among which were several lumps of unburnt mineral coal, which prove that that substance was sufficiently abundant in Roman Uriconium. On the eastern side of this structure, near the top, was a small furnace, in which there had been a fire so intensely hot that the whole internal surface was vitrified to some depth. From the form and posi-

tion of this little furnace, it is quite evident that it must have been heated by a powerful blast, no doubt of bellows, which, with their machinery, have long disappeared. By the side of this furnace, towards the interior of the room, stands upright a rudely-formed cylindrical stone, resembling the stump of a column, which was evidently used, in some way or other, for working metals which were melted or rendered malleable in the furnace adjacent. The form and position of these objects are shown in our cut; and another cut will enable me to illustrate, if not satisfactorily explain them. We find in engraved gems, and in other works of ancient art, rather numerous pictures of the forge of Vulcan, and of other scenes of a similar description, in which are represented both the furnace and the anvil. The first of those here represented, that to the right, is taken from



ROMAN ANVILS.

a sepulchral marble at Rome; the second, which represents Vulcan forging the thunderbolts for Jupiter, is furnished by a gem in the Cabinet Royal at Paris; and the third is taken from another engraved gem. I might easily add other examples, but it will be sufficient to remark that the form of the stand of the anvil is invariably the same—a short cylindrical stone, or stump of a column. On comparing these with the object in our room at Wroxeter, and considering its position, we can hardly hesitate in considering the latter to have been the support of an anvil. Now it happens, curiously, that in clearing the ruins of some of the buildings at but a short distance from this spot, a large lump of iron was found which had evidently been exposed to the action of fire, and from that cause, and the effects of decomposition, presented no very intelligible form. It lay upon a low remnant of a broken wall, as though it had been dropped there, and had evidently been carried away from its proper place. But, when examined a little more carefully, this lump of iron presents very evident appearances of having formed an anvil; and I feel convinced that it was

the anvil which once stood on the cylindrical block of stone before described, which would then still more exactly resemble the figures I have given from the ancient gems. Some one, probably at the time when people were breaking up the ruins to carry them off as building materials, seized upon this piece of iron, and would have carried it away also; but, finding it heavier than was convenient, he let it drop in this spot, and it was left there.

The smallness of the furnace is enough to convince us that the metal-works made on this anvil were not on a large scale; and there are other circumstances connected with the room itself which require consideration. Its front, bordering upon the forum, appears to have been open to the street, like the shop of a modern coach-builder, in two openings, separated by a pier of masonry, and no doubt capable of being closed with woodwork. The sides, indeed, are grooved for this purpose. On this side of the room, internally, there was a smooth floor of cement, nearly level with the sill of the entrance opening, and extending not quite to the middle of the room. Beyond this there is a floor at a much lower level, formed entirely of a very fine sand, which has been brought from a distance, and placed to a considerable thickness upon the natural soil of the spot. The only use we can easily imagine for this sand would be to form moulds for casting, and various other circumstances seem to show that this was in fact a workshop for the fabrication of small objects in metal. A considerable quantity of the scoriæ from molten metals were found scattered about here, both within the room and outside; and many fragments of worked metal, with about a dozen bronze hair-pins, a large bronze fibula, and various other objects, were picked up in the room. The floor of sand had been supported on the northern side by a low wall, between which and the northern wall of the room there had been a kind of pit, in which were found many pieces of scoriæ, and other apparent articles of refuse. On one side of the room, upon the sand, was found a quantity of pounded granite, which, I am told, might be used for the purpose of enamelling; and many fragments of fine glass were also scattered about. The occupants of this shop appear to have left it hastily, when the town was taken by the barbarians; for one of them, as he passed over the sill of the front opening into the street, dropped his money, which had been kept in a small earthen vessel, which he may perhaps have returned to his shop to fetch, when he was surprised by the plunderers as he was leaving. The little pot was found on the sill, near its northern end, at the spot shown in our cut of the furnace and anvil-stand, broken, and the money lying a little scattered about it. Among the latter was

found a small, thin disc of metal, which had no doubt been intended for a button or stud; its face very prettily ornamented, not exactly in enamel, but in work more resembling what is called "niello," or work not much unlike damaskeening. With it were also found some fragments of small globular ornaments, of such delicate make that they were too much broken to pieces to allow us to judge satisfactorily of the real character of the object to which they belonged. The stud, or button, had evidently, when dropped in the place where it was found, been fresh from the hand of the maker, and there is nothing opposed to the supposition that it was made in the workshop I have been describing, and which, therefore, may be assumed to have been that of a manufacturer of ornaments and small objects in metal, including, perhaps, the practise of the art of enamelling. It must be stated further that, on the higher floor of cement, near the south-western corner, there are the remains of another furnace, which was built of masonry, and heated by means of a flue; and that in the middle of the room there is a square mass of rather rough masonry, with a level surface about the height of the floor, which has either been intended to support some heavy object, or possibly to serve as a work-table. This mass of masonry is shown in the front of our cut, given above, with the higher floor to the left of it, and the lower floor of sand before it and to the right.

The existence of this workshop, and the manufacture of enamels and niello in it (if the conjecture be correct), would form an interesting fact in the history of mediæval art. There are reasons for believing that the art of enamelling was practised at a very early period in Western Europe; indeed, it has been supposed to have been invented in Gaul. It would be curious, therefore, to find the remains of an enameller's workshop which had been in active operation in a city of Britain at so early a date, and that on an apparently rather large scale. It would lead us to suppose, also, that the Anglo-Saxons, who were celebrated also at a very early period for their skill in the manufacture of jewellery, and in goldsmiths' work in general, had learnt their art from the jewellers and enamellers who remained in the Roman cities which had not been destroyed.

In calling attention to these few articles of antiquity belonging to a particular class, I would again repeat that, found within so small a compass as our researches have as yet extended, they must be taken only as evidence of what interesting discoveries we may yet expect if we are enabled to go on actively in our explorations. It is already certain that science and art were not unknown in Uriconium. We have only opened one building which was not of a public character, and that has turned out to be the shop of an artizan in metals.

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To the south of this, still facing the forum, is an extensive building, which appears to have been a market-place, or a store-house of some kind or other, and which requires farther examination. On the north, between the metal-worker's shop and the Basilica, with its front likewise to the forum, is another large, square room, which seems, like the workshop, to have been entered only from the forum, but which we have only yet examined sufficiently to assure ourselves that the walls internally are covered with stucco, or fresco. The opening was begun at the commencement of the season which would have been destructive to wall-paintings, and it was, therefore, abandoned temporarily. The excavations have since been carried on in other localities of the site of the ancient city, but slowly, in consequence, I regret to be compelled to state, of the paucity of funds at the disposal of the excavations committee.

PROTEAN ANIMALCULES.

BY HENRY J. SLACK, F.G.S.,

Member of the Microscopical Society of London.

THE older microscopists were much struck by the discovery of minute gelatinous creatures which, like the fabled Proteus, continually changed their form. Specimens of this family are very common in fresh and salt water, and they belong to the lowest order of the Protozoa,* if we except those which have a vegetable origin, and are not known to assume distinct animal characteristics. This order is named *Rhizopoda*, "root-footed," or *Pseudopoda*, "false-footed;" the first name intimating that their locomotive organs are like rootlets, while the latter points to their being distinguished from true feet. Simple as these beings are, they yet admit of divisions marking certain advances in organization, and they are separated by Dr. Carpenter, the great authority on this subject, into Reticularia, Radiolaria, and Lobosa. Our present business is with the third of these divisions, but their position in the world of nature would be unintelligible if we did not say something about the two which precede these in our list. The Reticularia are composed of a homogeneous granular protoplasm, with neither the nucleus nor the contractile vesicle which characterize higher forms of infusoria. Their *pseudopodia*, or false feet, are merely prolongations of the body, which can ramify

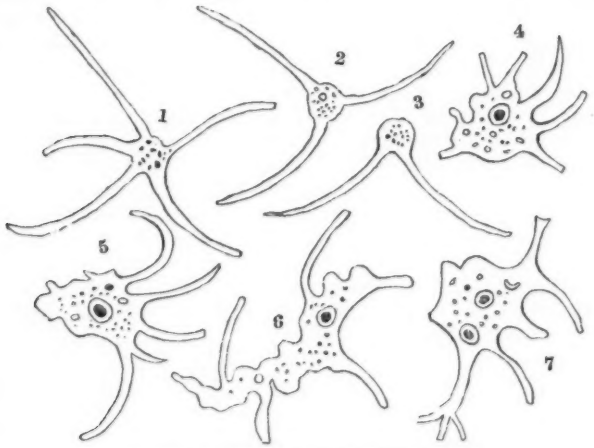
* First or elementary animals, distinguished from *Protophyta*, first or elementary plants.

minutely and adhere on contact.* In them we can trace no distinction between the substance which forms their surface, and that which lies below; in other words, they do not exhibit the difference between an *ectosarc*, or external flesh, performing the functions of an integument, and an *endosarc*, or internal flesh, which the former covers and protects. To the Reticularia belong the Foraminifera, whose minute shells are common on every shore, and enter largely into the composition of many strata in the globe. In point of time, the geologist assigns to them a venerable antiquity, and their diffusion in space extends over all climates, and the deep beds of the ocean which Dr. Wallich so ably explored. The Radiolaria have an *ectosarc* and an *endosarc*, and, some at least, a nucleus, or organ of reproduction, and a contractile vesicle. They are thus more highly organized than the Reticularia, and one specimen of them, the *Actinophrys sol*, is very common in fresh water. Some of them are in the water which furnishes the subject of this paper. They are irregular, granular-looking-globes, surrounded by slender pseudopodia, which stand out like the rays in old-fashioned engravings of the sun. Here are two pressed tightly together so as to flatten the adherent surfaces. They are in process of conjugation, and had they been left in the bottle, a happy family of sun-animalcules would have been the result. The third division of root-feet is the Lobosa, in which physiologists trace the progress of *differentiation*, or distinctions of parts, carried to a somewhat greater extent. It contains one family, the Amœbina.

Although specimens of the *Amœbæ*, such as furnished the matter for this paper, might have been obtained from various localities, it may be worth while to mention their origin, as it shows the value of keeping any materials we have collected, so long as they are in a hopeful state. In the month of September I ascended the uncockneyfied mountain of Carnedd Llewelyn, which belongs to the Snowdon group. Soon after leaving a little inn between Conway and Llanrwst, the route lay for miles across an ascending tract of moor land, and over a road composed alternately of holes and big stones, terminating in a slate quarry bounded on two sides by magnificent walls of perpendicular rock. There were no donkeys, guides, grand hotels, or other nuisances of more frequented ways; but a gray stone, here and there, marked the direction to the summit which we sought. After a steady pull up, Horne and Thornthwaite's mountain barometer—a pocket aneroid—proclaimed an elevation of 2600 feet, and a bottle was then filled from a little pool in which moss was growing, in order that, on our return, we might

* See Reichert's observations on this subject, and on the supposed rotation of granules, in INTELLECTUAL OBSERVER, xii., p. 471.

make acquaintance with the microscopic mountaineers. The sun was shining above a great field of clouds, intersected by numerous lines of clear air, through which his rays streamed; and as the lights and the shadows fell upon the distant plains, they mapped the land out in their own way, magnificently overriding the demarcations of man. As we came down, twilight began to make her magic changes in the scene; the mossy ground became inconspicuous, and one after another the members of the stoney world around us started into prominence, and seemed to wake like pre-Adamite monsters from a sleep. Weird phantoms of this kind, which belong to mountain regions, explain many of the superstitions of their human inhabitants;



AMŒBÆ, OR PROTEAN ANIMALCULES, × 420.

but our present business is with the bottle and its living contents, and we must not linger over another theme.

A few Rotifiers, mostly of the common sort, and a good many Water Bears, were the chief objects found in the moss. It was brought to London, put in a larger bottle with half a pint of fresh water, and left alone in a warm room. An occasional inspection revealed nothing particular, till in the middle of December the Actinophrys was plentiful, and a good many Amœbæ appeared. The latter were very small, as will be seen from the drawings of their aspect, when magnified more than 400 diameters. My first subject was in the shape shown in fig. 1, and looked like a five-rayed star-fish, but so transparent as to be put out of view by the least excess or faulty inclination of the light. My wife readily responded to an appeal to

take his portrait, but before she could bring pencil and paper he had assumed the form represented in fig. 4. Every moment the change went on, and figs. 5, 6, 7 give some of the most curious of his Protean shapes. Imbedded in his substance and undergoing digestion were various minute particles, and the *pseudopodia*, or, as I am tempted to call them, false *arms*, stretched about in every direction, often raising themselves above the level, and standing with their tips vertically over the general mass. I have often before had specimens of Amœbæ under the object-glass, but these were the most lively, and executed the most varied motions I had seen. Some of their pseudopod performances resembled the motion of the tentacles in that beautiful anemone, the *Anthea cereus*. Scarcely, however, had the vital character of the temporary organ and its movements been admired, before it disappeared. In went the long legs, out went the soft body, like a drop of slime flowing down a window pane, till it lost its shape. Gulfs and bays were formed in the plastic matter, and promontories protruded, and then subdivided, like the forked and craggy headlands of the Cornish coast.

Having spent some time in viewing this individual, another was hunted up, which exhibited the star-fish shape, and he was kind enough to permit my wife's rapid fingers to take his pattern, as the figure shows (fig. 1). Drawing these moveable creatures is exciting work; you must watch like a sportsman in a cover, not knowing whether a pheasant will rush up above his head, or a hare spring from beneath your feet. I am looking on as a calm spectator, but I see the pencil dashed on the paper, and fig. 2 gives another of the Protean fits. I take a peep through the microscope before the inconstant creature makes a fresh change; but quickly one leg disappears. I summon my wife, who is again fortunate in depicting our Pau-pukkeewis in his biped state, fig. 3.

Our good friends, the Hungarians, put their Christian names after their surnames, and naturalists do the same, with the appellations they bestow; so that Kossuth Louis, or Diosy Martin, of good vinous celebrity, may be likened to *Amœba diffluens*, or *Amœba radiosa*, the two species which our Proteus, with a characteristic contempt for systems, rolls into one. Had he preserved the radiate form as his principal pattern, he would have justified the separate name which was invented for him; but he, like his predecessor, was obstinate on this point, and for an hour or two *slobbered* himself about—the word is expressive and archaic—without once reverting to anything nearer his original aspect than may be found in figs. 4, 5, 6, and 7. A similar observation is quoted in Pritchard from Claparède, who says, "It appears almost absurd to attempt the distinc-

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tion of species amongst the Amœbæ, until we know something more of their intimate organization. Thus Ehrenberg's *A. radiosa* is characterized by the regularity of its processes and its generally stellate form when at rest; but when the creature creeps, it slowly expands, and the peculiar outline disappears; it flows along like a cloudy veil or drop of oil, and *A. radiosa* has became converted into *A. diffluens*."

Let me warn microscopists who do not know these creatures that they often look like faint smears upon the glass, and in that condition no one would dream they were alive who did not wait until a change of form was seen. I found it desirable to view them with powers of about 400 and 700; the former being most generally convenient, as requiring less change of focus when they altered their shapes, and caused portions of their bodies to approach or recede from the glass. The achromatic condenser, using the smallest hole, and cutting off all the marginal light, was very useful. If without it, I should have employed the spermaceti disk, recommended in last number, as the porcelain-white ground thus obtained is favourable to the perception of very transparent bodies. The light reflected from the inner surface of the white shade of Mr. Pillischer's lamp has a similar property. With the achromatic condenser an ordinary lamp should be turned low, as anything like a blaze puts the object completely out of view.

Dr. Carpenter* says, speaking of the Lobosa, to which our Proteus belongs, "The distinction between *ectosarc* and *endosarc* is here clearly marked, so that the body approaches much more closely in its characters to an ordinary cell-wall and cell-contents. . . . The ectosarc, which is perfectly pellucid, forms an almost membranous investment to the endosarc; still it is not possessed of such tenacity as to oppose a solution of its continuity at any point, for the introduction of alimentary particles, as for the extrusion of effete matter." Thus, if partially divided, it can stick together again, and heal immediately; a condition like that of the Scandinavian heroes in the Halls of Odin, who received mighty wounds for amusement in the morning, but were always ready for a dish of pig in the afternoon.

The *Amœba princeps* is larger, and, I believe, commoner, than the two so-called species which we have examined. It is also of a yellow colour, and its processes are less threadlike and pointed than those which the *diffluens* can put forth. Pritchard cites the descriptions which various authors give of twenty-three alleged species of Amœbæ, but they must be received without much faith in their validity, being for the most part founded upon distinctions of no zoological value. The

* *The Microscope*, 3rd edition, p. 460.

difference between the ectosarc and endosarc can only be demonstrated by the use of re-agents, and naturalists will be generally disposed to agree with Claparède that divisions which are not based upon structure have little title to respect. The Amœbæ, whose animality is undoubted, *flow over* their meals and take them in at any part of their bodies. Whether those which have a vegetable origin take in foreign matter and digest it in this way, has not yet been decided. They may not be exponents of a transition from the vegetable to the animal world, but they are assuredly interesting connecting links, and with similar links help to bind the realms of organization into one infinitely varied and widespread whole.

EXCAVATIONS AT ROME.

Dr. Deakin writes, "I have just been to see the progress the excavators are making in the site of the Palace of the Cæsars. You will remember that this palace is situated upon, and in fact entirely covered, one of the seven hills of Rome, viz., the Palatine, and that in its present state it is about one and a-half miles in circumference; the whole hill is now a mass of brickwork, broken up into ruins of endless form, and in some parts covered up twenty feet beneath the present surface with broken fragments of brickwork, various kinds of marble columns, shattered slabs of marble which encased the walls, cornices and mouldings of various designs, some of them most elegant, and their angles as sharp as though the workmen had only just finished them; but they are all so broken up that it is rare to find portions larger than a truncated column; it is known, however, that these ruins have been a vast store-house, as it were, from whence materials were taken for the erection of other buildings, and that even in the time of Sixtus V. he had materials from this ruin, and probably from the Colosseum, to assist in building St. Peter's, and how many of other churches and buildings have been erected from these ruins it is impossible to know; it is therefore not to be wondered that the remaining mass which covers up the foundation of the building should be as it is found, chiefly plaster and cement, mixed with only small portions of marble and comparatively few bricks and stone. No statues of any importance have hitherto been found, and it is probable that there are not any left that have escaped former excavators. There is, however, great interest attached to these excavations, as it is hoped that they will enable us to make, from the existing foundations, plans of the ancient palace and other buildings attached to it, and as the Palatine is

the hill upon which Romulus, the founder of Rome and the Romans as a nation, first established himself.

"The first object of attention upon examining the excavations is a portion of public road which leads up to the palace, and was a branch of the Via Sacra from the *Summa*, the spot where the Arch of Titus stands, and, like the rest of the road, it is formed of large irregular-shaped blocks of volcanic stone; one of these at the top of the ascent is about eight feet long and four wide, near this are the foundation of brick walls forming small compartments; in other adjacent parts are numerous long, lofty, arched passages, branching off into numerous others, and into small apartments, some of which it appears were dark, as there is no appearance of apertures for the admission of light; some look as though they had been baths, the walls encased in marble, and the ceiling adorned with frescoes representing dolphins, etc., emblematic of the sea or water. Many of these paintings are almost as fresh in colour as though they had been only lately painted; the walls and arches, which are very massive, are all built of bricks, but on the eastern side of the hill overlooking the site of the Circus Maximus, some structures have been laid bare formed of large squared blocks of tufa placed upon each other without cement between them, in the form of large pillars, about sixteen feet high, supporting arches; these it is thought are some of the earliest structures in Rome, being built at the period of the Roman kings—that is, between the years 753—510 B.C. They are of Etruscan architecture, and very similar to the Cloaca Maxima and the walls of the Mamertine prisons; these ancient foundations formed the substructure upon which Augustus built his imperial palace, and the remains of what was the celebrated Palatine Library, an academy which had three or four elevated seats round it in the form of an amphitheatre; besides these, the traces of other spacious halls may be seen, as well as the foundations of what is supposed to have been a portico, formed of numerous lofty columns. All these buildings were made of massive brick-work, and encased with marble slabs, some portions of which still remain, as well as part of the marble pavement. Much, however, must still be done in the way of excavations before we can form an idea of what the buildings erected here were; indeed the difficulty of forming any accurate plan is very great, as the remains of former buildings which have been destroyed have been made use of as the foundation for others, and these again altered, and other portions added by various emperors at different periods."

THE MERLIN.

(*Falco Æsalon.*)

BY ROBERT GRAY,

Secretary to the Natural History Society of Glasgow.

THERE is nothing in the possession of an ornithologist of greater interest to him than well-preserved skins of those birds which he has himself captured. Nearly every specimen recalls adventures by "flood or field," and presents memorable pictures more vividly, indeed, than the famed sketches of Joseph Wolf, whose unrivalled pencil may almost in this respect dispute the claims of any collection, however distinguished. Even though the collector should possess several birds of the same species, each may have its own romance, investing the dried skin with all the advantages of a note-book, and calling up recollections of bird-life by the sea-shore or mountain side, by peaceful glens, and brawling rivers.

In Scotland especially, where scenery is so varied and bird-inviting, these remarks suggest themselves naturally to any one engaged in ornithological pursuits, its friths and forests being yet the dwelling-places of species long since rare in the south, and its mountains yet honoured by the eagle's throne. Inland waters still protect the wild goose and phalarope; rugged headlands the erne and the peregrine; and through the long summer months, on the Hebridean shores, the loud and melancholy cry of the great northern diver strikes on the ear. To be one's self the medium, therefore, of obtaining these desirable birds is no fireside matter, but involves journeys of hardship and endurance, and sometimes adventures not without risk, but all more than repaid by the objects of pursuit, placed, it may be but occasionally, before the eye for inspection, though never failing to bring back pictures of places for ever gone to the sight.

The following observations on the Merlin have been suggested by an examination of three fine specimens in my collection of birds of prey. They were shot by myself. There is nothing particular to narrate in connection with these three but the offences for which they were convicted. One, a young bird of the first winter, was cut down in a juvenile foray amongst a covey of partridges, probably his first infringement of the game laws; another disregarded my fowling-piece at thirty yards after lifting a barn-door duckling; while the third was killed as he seized a towering snipe, and fell with a splash, prey in hand, into the marsh whence the prey had risen. As they lie on the table before me they carry the mind to distant

scenes with a peculiar vividness, recalling not only the interest of their own capture, but reminding me of impressions of their haunts and birthplaces, like the nameless mountain stream—

> "Over the moorland, purple dyed,
> Over the rifts of granite grey,
> Up to thy source on the mountain side,
> Far away—Oh, far away."

The Merlin is extremely interesting from its daring spirit and activity in pursuit of prey. It will rush headlong anywhere when fairly excited, and is rarely baffled in its hunting expeditions, however large the object of chase. I have seen one, however, follow a wheat-ear into a rabbits' hole, coming out unsuccessful, and darting away with a peculiar suddenness, after shaking the sand from off his back; and the handsome little fellow now in my hand had missed a rock pipit twenty times before he dashed among the partridges. The pipit darted hither and thither in such fear and perplexity, that by its zig-zag movements it fairly defeated the aim of the Merlin as he rose and came down to clutch it. But it does not often allow its prey in this way to escape, the chase being usually persisted in with a courage and determination quite extraordinary in a bird so small. With the rapidity of an arrow it will fly along some enclosure, by the hedgerows, seize an object, and glide out of sight, leaving the spectator to marvel at the transaction as at a deed of magic. It is, indeed, almost impossible on such occasions for the eye to follow its movements.

On the east of Scotland, where I studied the habits of raptorial birds for many years, I remember some years ago seeing this falcon capturing snipes very cleverly at the seashore. At a particular part of the coast, near Dunbar, where a rivulet enters the sea, the snipes fed in great numbers at low tide, the ground, which was covered with small brown pebbles, being well adapted for the concealment of birds. With the most punctual regularity a pair of Merlins used to come, as I made my appearance every morning at this place, and hover about till I had raised a brace, which were immediately pounced upon. But after a time the snipes became so terror-stricken that a hundred shots would not frighten them; nor could a single bird be raised, though I saw them occasionally skulking under the stones. I found them more than once indeed paralyzed with fear, and so heedless of anything save the hawks, that I was able to pick up one or two and transfer them to my bag, while my two friends were flying overhead, disappointed of their usual supply, and doubtless in wonder at this sporting novelty. Ultimately, however—for the snipes persisted in frequenting the place, though an unusual one—these birds acquired so much cunning, that they ran to conceal themselves

under the slimy stones below tide mark, thrusting their bodies, crab-like, into the crevices as soon as these Merlins and I came in sight! At such times their hurry was very diverting; and as the facts I narrate extended over a length of time, I could not help being struck with the behaviour of the snipes during the protracted disturbance they were subjected to.

The Merlin makes its nest, as I have observed in various parts of Scotland, in wild tracts of moorland amongst heather, the spot selected being generally near a ravine or moderate precipice of rock, on the summit and walls of which tufts of heath are growing. The nest is composed of small sticks and stalks of heather, but is without any lining. The eggs are from three to five in number, and of a dark, close-grained red, subject to almost no variety. They are, in fact, more easily recognized than those of other rapacious birds. I have specimens from Kinross-shire, Argyleshire, and Aberdeenshire, and all are closely alike. The bird itself is found, I should think, in almost every Scottish county. I have observed it to be tolerably common in East Lothian, especially on the sea coast, where it could satisfy its partiality for shore birds. It seems to prefer sanderlings, dunlins, and snipes, these being oftenest found in its nest, though it be situated on some moor at a considerable distance from the sea. I have seen it also killing larks.

I remember on one occasion finding a Merlin's nest on one of the Haddingtonshire moors, by the side of a ravine filled with great square blocks of gray rock, and clumps of feathery birch-trees, the banks being decorated with patches of beautiful heather and luxuriant grass. On a little platform near the summit of one of these blocks, which appeared ready to tumble into the glen, the nest was placed beside a tuft of heath, with three fine stalks of foxglove bending slightly forwards and gracefully shaking their bells over the heads of the young falcons as they sat waiting an arrival. I was about ten feet above them, peeping over the embankment under a spreading hazel, and well out of sight of the old birds should they come. They sat like miniature eagles in a line facing the course of the tumbling burn at the bottom of the ravine, and I could discern nothing like an impatient look in any of them. They appeared to be in full feather, and I could not help admiring the four healthy fellows, in an attitude of repose, on their picturesque watch-tower, even though it savoured badly of unfinished dinners and the trampled remains of seafaring dotterel. Taking an old letter from my pocket, I tore off several bits and let them down in a shower on their backs, which had the effect of making each give his neighbour a smart rap on the side of the head, and lift first one foot then the other, as if the perch were becoming too hot for them. But just as

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I was about to repeat the infliction, their mother pitched down suddenly beside them with a golden plover in her claws, which she laid down unconcernedly, as I thought, but in reality relaxing her grasp with a truly inquiring look at so many visitor's cards on the premises. In an instant she looked in all directions, and at once divining nothing good from my head between her and the sky, she disappeared like a thought. I then took a stick and threw it down upon the family, who broke up by falling and fluttering into space till they fairly took wing and glided from me in different directions; so, as they had not touched the plover, I scrambled to the deserted platform and carried it off. It is not likely they would miss it, as I have no doubt that within the next half hour the little rascals were killing their first bird on the adjoining moor.

The Merlin breeds on the island of Benbecula, one of the Hebrides, whence I procured both the bird and its egg, last summer. A beautiful male from this interesting locality is one of the richest coloured I have seen, the blue on the back and buff orange on the neck and thighs being very pure. This specimen is but ten and a half inches in length. Another male before me measures twelve inches, while the female is thirteen. In the month of July last a friend trapped for me on an Argyleshire moor two old birds and their four young ones, just fledged. They were despatched to me alive and uninjured, but to my regret I found the male had died on the journey, and was trampled into a shapeless mass by his fellow prisoners. There is but little difference between the plumage of the female and that of a full-feathered young bird of either sex; but in some adult females I observe several blue feathers appearing on the back, as if in process of moulting; a circumstance which induces me to remark that at a recent meeting of the Natural History Society of Glasgow, Dr. Dewar observed in connection with the peregrine falcon, that he had shot females on their nests having the whole of the upper plumage spotted with blue feathers. In the first case are we to suppose that the female Merlin at a certain age occasionally assumes the plumage of the male, or, in the other, must we believe that the peregrine falcon breeds before arriving at maturity?

QUETELET ON SHOOTING-STARS.

M. QUETELET devotes a chapter of his *Physique du Globe* to "Shooting Stars," and the following passages contain the most interesting information in a condensed form. He tells us that the first efforts to observe these bodies in a scientific way were made by two students at Göttingen, Brandes, and Benzenberg, who began their labours in 1798, and published their first researches at Hamburg in 1800. Olbers and Chladni encouraged these young men, but attention might not have been generally excited to the subject if Humboldt and Bonpland had not astonished the world by their account of the splendid shower of falling stars which they observed in America on the 15th of November, 1799. In 1824 Quetelet took up the study of these bodies at Brussels, especially with a view to determine their heights, velocities, and trajectories—subjects on which the two young Germans had previously laboured. In 1837 Benzenberg addressed a long letter to Quetelet, describing the investigations in which he had been engaged. He considered, with other authorities, that shooting-stars were stones ejected by lunar volcanoes, and circulating round the world by millions. Having this notion he called the moon an "inconvenient neighbour."

In 1836 M. Quetelet informs us that only five cases existed in which the velocities of shooting-stars had been calculated, and in the following year he invited a general concurrence of observers in various countries. The 13th of November was ascertained to be the date of the annual recurrence of the phenomena on a large scale in America, while the 10th of August had been found prolific in Europe. In six cases M. Quetelet computed the velocities of falling stars, and obtained an average of five leagues, each equal to a twentieth of a degree, per second. Various opinions were given as to the number of these meteors on ordinary nights, and Sir John Herschel thought a single observer might reckon upon seeing sixteen per hour, and would not consider the night extraordinary if he did not see twice as many. The pupils of the observatory in Paris, each looking to one half of the sky, had noticed forty to fifty per hour, but Arago reckoned twelve to fifteen as a mean quantity. In America, Mr. Herrick spoke of fifty or sixty an hour between three and six o'clock a.m., and about twenty-five from six to ten p.m., as being about the total number visible. M. Quetelet remarks, "I will not insist upon the quantity a single observer may see, but there is an important distinction to establish, which is, that the latter part of the night offers double the chance of the beginning. This, if proved, would

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be a strong argument in considering the probable origin of shooting-stars."

During their passage, shooting-stars sometimes emit a series of sparks, or leave behind them a luminous train, the duration of which varies. Their colour likewise differs, and sometimes changes during the passage of the same meteor. The straight course which they generally appear to take is not invariable, for in some cases a sensible curvature is noticed, and on rare occasions one may be seen to deviate abruptly from its primitive direction.

So far back as 1762, Musschenbroek observed in his *Treatise on Physics*, "that shooting-stars were often seen in spring and autumn," and in another passage he specially indicated their appearance in the month of August. This appears to have been forgotten when Humboldt published his account of the showers of these objects which he witnessed in America.

In an article published by Schummacher, in his *Year Book*, Olbers observed, that an immense quantity of planetary corpuscules, forming shooting-stars, appeared to move in orbits round the sun, and traverse the earth's orbit between eighteen and twenty-one degrees of Taurus. The orbits of the bodies were approximated and nearly parallel, and they furnished routes for myriads of infinitely small asteroids, whose revolution, he considered, was completed in from three to six years. Moreover, they appeared to be very unequally distributed, being densely accumulated in some portions of the orbit, and thinly scattered in others. M. Quetelet remarks that it "must be observed that the group of shooting-stars of the 11th and 12th of November has been scarcely noticed for ten years," and he asks "whether it has actually disappeared, or whether there is a certain periodicity in its returns." He adds, during the last century the months of August and November were already noted for the frequency of shooting-stars; and that the idea of singling out the 10th of August was suggested not by Musschenbroek, but by his own researches, and it seems that a quantity of these meteors was observed on that day in the years 1800, '1, '6, '9, '11, '13, '15, '18, '19, '20, '22, '23, '24, '25, '26, '27, '28, '29, '30, '31, '33, '34, '35, '36, '37, '38, '39, '40, '41, '42, '44, '45, '47, '49, '50, '52, '53, '55, '56, '57, '58, '59, and '60.

After M. Quetelet had pointed to the 10th of August, a manuscript of a work in the last century was shown to him, in which the same date was associated with *meteorodes*, and Mr. Forster, in his *Pocket Encyclopædia of Natural Phenomena*, stated that the Roman Catholics of Ireland had a tradition representing the shooting-stars of this period as the burning tears of St. Lawrence, whose *fête* was on the very day. *Silliman's Journal* also cites a Thessalian belief that the heavens

opened on the night of the transfiguration, 6th of August, and permitted the celestial *candles* to be seen. M. Biot likewise is of opinion that the appearances of shooting-stars in August and November are the same as the phenomena which are made to figure fifteen days later in Chinese catalogues.

M. Coulvier-Gravier has put forward the opinion that the meteoric appearances of August tend to grow less every year; but the records of observations do not indicate any law of decrease, and in some years, such as 1843, '46, and '51, the weather was extremely unfavourable at that date. In addition to the November and August periods, M. Quetelet finds the nights of the middle of October, and those of the 7th of December, and 2nd of January, prolific in shooting-stars.

M. Quetelet gives an elaborate table of the chief appearances of shooting-stars, from the earliest records down to 1860, and it is not surprising to find that superstition had often connected their movements with "wrath to man." In 1726 one of the most brilliant star-showers appeared in Europe, and at eight o'clock in the evening of the 19th of October, an observer at Liege states that for two hours the sky was inflamed by these meteors, so that it was easy to read or distinguish objects.

Arago remarks that falls of aërolites, appearances of bolides, and sporadic shooting-stars are much more numerous from July to December, than from January to June. "The earth," says this philosopher, "meets with a much greater number of cosmical meteors in proceeding from its aphelion to its perihelion, than when moving from the perihelion to the aphelion."

Concerning the origin of shooting-stars M. Quetelet remarks that opinions have varied most amongst those who have devoted most attention to them. They have alternately ascribed to these meteors a cosmic or an atmospheric origin, and the cause of the hesitation appears to be "insufficient and false notions of the constitution and height of our atmosphere." Moreover, "they have not on any single occasion been able to see or touch the substance of a shooting-star." Up to the present time M. Quetelet says it has been admitted without contradiction that our atmosphere is of uniform composition from the earth's surface to its greatest height, estimated at sixteen or twenty leagues, and its movement has been supposed coincident with that of the globe. But, he asks, are these assumptions true? "If," he proceeds to observe, "the action of other bodies in the neighbourhood of the earth was *nil*, the atmosphere, under the sole influence of its weight, would remain adherent to the globe, and uniformly partake of its movements as we suppose. But during the day the air is

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unequally heated throughout its height, and particularly near the earth, where it is dilated by the direct rays of the sun, and by those reflected from the soil. This double heating is the more felt in proportion as the layer which it affects is denser than those which are above it." Then, as explained in our last number in the article on "Atmospheric Electricity," the atmosphere is divided into two portions, the one uppermost *stable*, and the other lower and *instable*. The height of the latter will vary according to the season, and the amount of heat acting upon it. In the lower or instable region, rain is prepared and storms burst forth; while in the higher and calmer region, M. Quetelet considers that the phenomena of auroras, shooting-stars, and the "great magnetic changes which manifest themselves by diurnal and monthly variations of the needle occur." The elements of this higher medium, destitute of moisture, are not "essentially" the same as those of the instable atmosphere, which, being constantly moved, is nearly identical in all its parts. It is difficult to estimate the height of the boundary which separates the two portions, but an approximation may be made by noticing cirrous clouds, which often stop at the base of the stable division, and which seems to be at least twice as high in summer as in winter. Similar indications, as explained in the article just alluded to, are given by electrical actions, which show that in winter the stable atmosphere, which from its dryness is a bad conductor, approaches nearer to the earth.

The stable part of the atmosphere differs, according to M. Quetelet, very widely from the ideas generally formed of it. Its height is three times what is supposed, and its composition may differ from that which is assumed. The best mode of studying it he considers to be by noticing its effects upon bodies passing through it like shooting-stars. These bodies become visible at elevations which may be estimated at fifty or sixty leagues; as they come nearer to the earth, their lustre increases, and they disappear completely as they approach the regions from whence we observe them, "as if they no longer found the elements necessary for them—as if they had passed into a medium which precluded their conservation." The instable atmosphere has its elements constantly mixed by motion and other causes, the stable atmosphere may permit them to separate according to their gravity. We may also ask whether the diurnal movement of the earth exactly corresponds with that of the atmosphere, and if the times of their revolutions are equal. This may be doubted, especially if we consider that the upper portion, which ought to have this movement, presses on the lower portion, which is continually agitated in an opposite direction. "Their movements of rotation ought naturally to differ, as in the planet Saturn the two portions of the ring

have a rotatory motion separate from each other, and from that of the planet. The rotation of our upper atmosphere differs in like manner, according to our view, from that of the rest of the globe, and thus affords a sufficient explanation of the displacement of the magnetic poles, and of other phenomena that would be difficult to account for in any other way."*

"If the atmosphere is regarded as described, it is not surprising that shooting-stars would traverse its upper regions, and be extinguished as they reach the lower portions in which we live. We also can imagine that auroras would generally arrange themselves along the boundary which separates the stable from the instable atmosphere, which is also the limit in which direction are found the magnetic forces that agitate our globe. These phenomena, which occur at moderate altitudes, may, by the same causes, be made to operate all over the northern hemisphere, and exhibit themselves with nearly equal intensity in Europe, and in the northern parts of Asia and of America."

M. Quetelet observes that shooting-stars are so common that no attentive observer will wait an hour without seeing one, although the latter half of both year and night are most prolific, and North America usually exhibits more than are seen in the "climates of Europe or Asia." These facts have not, he considers, been studied with the attention they deserve, although they seem likely to lead to the knowledge whether shooting-stars are produced in our atmosphere or enter it from without. The quantities of shooting-stars in different months and seasons are represented in the appended diagram, which we borrow from the *Physique du Globe*. The great outburst in August is followed by a striking diminution in September. In October there is a rise in the curve, which reaches its extreme winter range in November. In April, the curve reaches its spring elevation, which is much lower than that of the winter. In June the lowest period is reached, and with recurring August the shooting-star power once more culminates.

M. Quetelet noticing that shooting-stars appear to be confined to the upper and stable portion of our atmosphere, asks whether we are to ascribe to them some peculiarity which keeps them away from the earth, or to regard them simply as instances of ignition, the light of which can be seen from

* "We have seen," says M. Quetelet in a note, "that with us the magnetic declination will pass from a maximum to 0 in about 125 years, which gives a mean of 250 years as the interval between the maximum and the minimum instant, or 500 years as the period of the declination's needle's return to the same magnetic position. We suppose in this calculation a regular movement of the needle, which does not vary in the course of centuries. Does this movement take place because the magnetic pole is effectively above the earth, or does it arise from the influence exerted upon the atmosphere in general by a magnetic pole placed in the interior of our globe, and having a proper motion? This last hypothesis appears the most probable."

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certain elevations, and becomes extinguished as the bodies approach our denser and perhaps different atmosphere. Shooting-stars must, he considers, be regarded as of a different nature from aërolites, bolides, and falls of dust.

Aërolites he considers as strangers to our globe, and, unlike shooting-stars which have never been touched, have frequently undergone chemical investigation, and present a tolerably uniform composition. Aërolites and bolides are very rare, as compared with shooting-stars.

Bolides are described by Arago as "globes of fire which

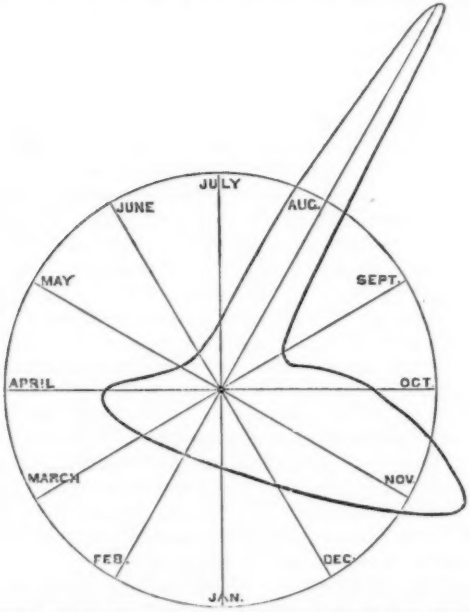

DIAGRAM SHOWING THE FREQUENCY OF SHOOTING STARS IN DIFFERENT MONTHS.

appear suddenly, and vanish forthwith, after spreading around them a brilliant light, which lasts for some seconds. Their form is circular, and they exhibit an appreciable diameter. They illuminate the horizon with a light usually rather weaker than that of the moon. They often leave a train behind them visible for longer or shorter time. Sometimes they burst into pieces, which continue their course, and are soon extinguished, and their fragments form the aërolites found on the surface of the earth." Dust-showers of materials similar to aërolites are much more rare, and appear to be of similar origin.

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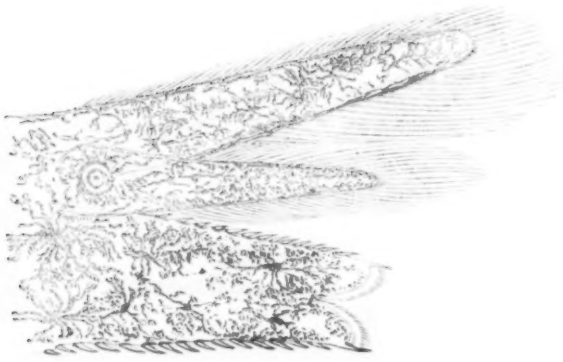

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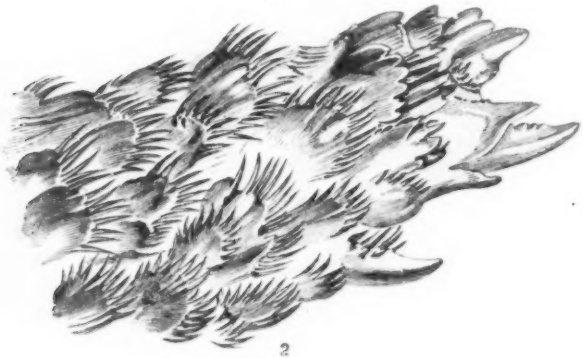

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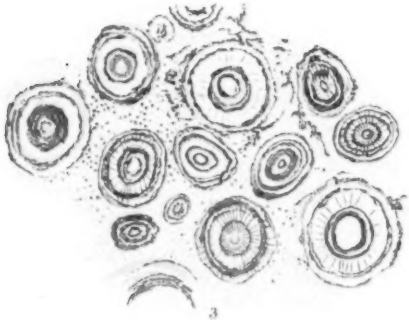

3

STALK-EYED CRUSTACEA.

BY GEORGE S. BRADY, M.R.C.S.

(*With a Tinted Plate.*)

THE "Stalk-eyed" Crustacea are more fortunate than their allies, the "sessile-eyed" tribes and the Entomostraca, in so far as they claim a large share of attention, not only from naturalists, but from that much wider class whose interest about them culminates in the achievements of Soyer or "Meg Dodds." Yet we do not know any reason, beyond their generally diminutive size, why the sessile-eyed species should be inferior in a gastronomical point of view to their stalk-eyed relatives,—why a dish of sandhoppers, for instance (especially of such giants as we have seen frisking on the shell-beach of Herm), should be worse than a dish of shrimps. We must confess, however, that we should need to be very hungry indeed before consenting to appease "the keen demands of appetite" by recourse to a fry of the great sea-slater (*Lygia oceanica*), no matter how juicy and well-favoured the specimens might be. After all, Mr. Gosse speaks well of the culinary qualities of *Bunodes crassicornis* (one of the common sea anemones) when cooked with egg and bread-crumbs, and if such a leathery animal can be made decently edible, we need scarcely despair of sea-slaters. In the Channel Islands the natives seem to eat everything that their shores produce, from "ormers" and spider-crabs, to hedgehogs and sea-urchins, the difficulty being to say what they do *not* eat. The quantity of the larger stalk-eyed species consumed in England and Scotland is prodigious. Mr. Bell tells us that from Norway alone not less than 600,000 lobsters per annum are sent to London, and from Scotland about one-fourth of that number, as well as great numbers from other parts of England and from the Channel Islands. Besides this species, the spiny lobster (*Palinurus vulgaris*), and the great crab (*Cancer Pagurus*), are extensively eaten, and the small Norway lobster (*Nephrops Norvegicus*) is brought in considerable numbers into many of our ports. It is much more delicate in flavour than the common lobster, though not held in nearly so great esteem. These, with the prawns and shrimps, are the chief species of stalk-eyed Crustacea whose economical uses call for notice.

Every Crustacean consists theoretically of twenty-one segments, seven of these being assigned to the head, seven to the

thorax, and seven to the abdomen; but in no one species can all these parts be distinguished, as several of them are always soldered together into one solid piece; it is only by comparison with others that their existence can be demonstrated, but the rule may be usefully borne in mind that every pair of limbs indicates the position of a segment. The seven segments of the head are compressed into very small space, and give attachment to the following members:—(1) the eye-stalks, (2, 3) the upper and lower antennæ, (4) the mandibles or jaws, (5, 6) the two pairs of maxillæ, (7) the first pair of foot-jaws. In the stalk-eyed species the thorax is entirely covered by a large shield or "carapace," which protects the more important viscera, viz., the stomach, liver, heart, genital organs, and branchiæ. The carapace consists of the seven thoracic segments firmly cemented together, from beneath which spring (1, 2) the second and third pairs of foot-jaws, and (3—7) the five pairs of true feet. The abdomen gives attachment to the five pairs of false or swimming feet, the swimming plates of the tail, and to two rudimentary appendages at the very extremity of the body. In the case of the common prawn (*Palæmon serratus*) all the members may be easily separated; but the division of the *body* is much better seen in the sessile-eyed Crustacea, which are destitute of a carapace, the rings of the thorax being separate and continuous from side to side.

In some stalk-eyed species, such as the crabs (*Brachyura*), the abdomen is very small, and is kept constantly doubled under the thorax; in others, such as the lobster, it is very largely developed, and constitutes a powerful swimming organ; nor need we be astonished at the prodigious strength of the animal's tail when we see the compact mass of muscle with which almost the whole abdominal cavity is filled, the sole purpose of which is to provide locomotive power. The flesh of the lobster exhibits the structural peculiarities of muscular fibre very beautifully, and may be advantageously used for microscopic preparations of this kind. If boiled before being used it will be found to split up much more easily into its ultimate fibrillæ. Not only the lobster, but any species of prawn, shrimp, or crab, will afford excellent examples.

Dissection of the lobster affords an admirable illustration of some most curious and interesting physiological phenomena. Supposing the animal to be dead, and the abdomen to be perfectly separated from the rest of the body, it will be found that when the muscular tissue of the abdomen is irritated by the scalpel, violent contractions are produced, the tail is forcibly flexed and extended, and the false feet flap vigorously. All this happens even though the creature may have been dead for

several hours, and the facts are easily explained by a reference to the structure of the lobster's nervous system. In the head there is a mass of nervous matter, not very large, which may be looked upon as the brain, and springing from it are two nerve cords, which run along on opposite sides of the body to its extremity, communicating on their course with certain smaller masses of nervous tissue termed ganglia, which lie laterally on each segment of the body. The brain and the ganglia are composed of gray nerve matter, and may be considered as the batteries or reservoirs of nervous force; the connecting cords, on the other hand, are composed of white nerve tissue, and are merely, so to speak, the wires which convey the force generated by the gray matter. Thus it follows that even when the head and brain are removed, there yet remains in the abdominal ganglia a sufficient supply of nervous influence to produce, when called into action, great appearance of vitality. And the means of calling it forth are simple. When the external or peripheral extremity of a nerve is irritated by the scalpel or other means, the irritation passes immediately along the nerve fibre to its ganglion, and is thence reflected along another fibre to the muscle, thus causing involuntary contraction. The nerve receiving the irritating impression is termed *afferent*, and that which transmits the motor impulse *efferent;* the whole series of phenomena being aptly termed "reflex nervous action." And all this may take place without the production of pain or sensation of any kind. Even in the higher animals and in man the same unconscious movements may be produced in cases where, either by disease or accident, the sensory ganglia have been injured or their communication with the motor tracts destroyed.

The ova of these Crustacea are very small in proportion to the size of the animal, but their number is enormous. Doubtless immense quantities of them fall a prey to the voracity of fishes while in their larval stages of growth, and it is certain that only an infinitesimal portion attain to full development. The transformations which they undergo have been briefly described in a previous number.* It is interesting to note these in connexion with the small size of the ova, as affording a confirmation of the theory of M. de Quatrefages,† that the amount of pabulum afforded by the ovum itself exercises great influence on the extent of development which takes place before hatching. We may observe also that the large proportionate size of the eggs of rotifers furnishes a strong reason against their being associated with Crustacea, and in favour of their claims to a place near the insects. The larval transformations

* Intellectual Observer, No. 6, p. 419.

† *Ibid.*, No. 8, p. 99.

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being completed, further growth of the animal is provided for by a series of moultings. These take place annually until the full size is attained, after which it is believed that no further exuviation occurs. The moulting season is usually August and September. When it is about to occur, the creature becomes listless and timid, and retires to some protected hole or rocky crevice where it can shuffle off its calcareous coil in quiet and security. The process appears to be performed somewhat differently in different species. In some the feet are simply pulled out, as if out of a boot; while in others both the claws and the carapace are split up in determinate lines, thus allowing an easier exit to the animal. A great increase in bulk takes place immediately on casting off the old shell, so that seeing the newly emancipated crab and its cast coat side by side, it is difficult to believe that the one has so recently been the tenant of the other. The hardening of the new shell takes place very rapidly, and thus further growth is precluded until the moulting season again arrives. Mr. Gosse has given an account of the moulting of a Maia, or spider crab, which he was fortunate enough to have the opportunity of observing.* He says there was not "any of the struggling that is sometimes spoken of; it seemed to be a very easy and simple matter. The new integuments were perfected, though soft, before the old were thrown off, and the immediate cause of the separation of the crust appears to be the sudden growth of the animal within forcing asunder the upper and lower crusts at the posterior margin; then the pulling out of the limbs presents no more difficulty than what depends on the enfeebled condition of muscular energy."

The spontaneous rejection of limbs, and their complete restoration after having been so lost, are among the most remarkable endowments of this group of Crustacea. It is said that the noise of a thunderstorm or the report of cannon will cause crabs and lobsters to throw off their claws; and it is certain that the infliction of sudden injury will do so. When the injury has been produced without great or sudden violence, the limb is very likely to be retained, and the animal will probably bleed to death. In such cases fishermen are accustomed either to wrench the leg off at the first joint, or to strike it violently, so as to cause the creature itself to effect the dismemberment. In either case the wound heals over quickly, and the effusion of blood is stopped. Mr. Goodsir asserts that this salutary effect is produced by means of a glandular body situated at the base of the limb, which rapidly secretes a membrane over the stump, and in process of time entirely restores the missing part, though mostly on a smaller scale than before. Some species part with

* *Ann. and Mag. Nat. Hist.*, 1852, p. 210.

their limbs much more readily than others. The "*sleight* of hand" performances, for instance, of the little broad claw (*Porcellana platycheles*) are quite astonishing, so that among the multitudes which are often seen on turning over a stone near low-water mark it is not always easy to procure many perfect specimens. If nipped up by the claw they are almost certain to make off very quickly, leaving the limb behind in the grasp of your forceps or your fingers. This seems to be done without the least exertion; so easily, indeed, that it is impossible to suppose it other than a painless process. Even after being thus cast off the limb continues for some time to twitch spasmodically, thus increasing the suffering of any living thing which it may have included in its grasp.

Among the most curious of the stalk-eyed species are the Paguri or "Hermit Crabs." These animals have the front of the body only covered with the ordinary calcareous shell, the abdomen being quite soft and destitute of natural protection. But in order to obtain the requisite security the crab takes possession of the deserted shell of some univalve mollusc, into which he inserts his hind-quarters, remaining in it until his increasing size renders a more commodious tenement necessary, when he flits into a shell of larger dimensions. The common Hermit Crab (*Pagurus Bernhardus*) attains, when full grown, to a considerable size, adult specimens measuring about five inches in length, and requiring for their accommodation the largest shells of the whelk (*Buccinum undatum*). It is a question whether the crabs destroy and dispossess molluscs of their shells, or whether they merely appropriate such as they find empty. The fishermen in some districts seem persuaded that the former is the fact; but they are not always the most trustworthy observers.

A very interesting point in the history of the Hermit Crabs is the companionship which appears to exist between them and one of the sea anemones (*Adamsia palliata*). This pretty species is constantly found adhering round the mouth of univalve shells, and is almost always associated with some species of Pagurus, the crab appropriating the inside, the anemone the outside of the shell. Whether the companionship be more than accidental is not certainly known.

A still more curious instance of companionship exists in the genus *Pinnotheres*. These little crabs inhabit not dead and disused shells, but are actually co-tenants with the living mussel and pinna. It is only in the larger mussels that the creature is found, and the size of the crab with its claws spread is generally sufficient to occupy the full diameter of the shell. These crabs are quite soft, and no doubt incapable of existence except with protection of this kind; but the relationship gave

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rise in old times to strange fables. Aristotle says,* "The pinnæ always contains a pinnophylax, either like a small caris or cancer, and soon die when this is extracted. . . . These animals apparently never grow, and the fishermen say they are produced at the same time as the creatures they inhabit." Pliny is much more amusing; he devotes a chapter to an account "of the nacre and his guide or keeper pinnoter, and the perceivance of fishes." The following passage gives his ideas respecting Pinnotheres.† "The nacre, also called pinnæ, is of the kind of shell-fishes. It is alwaies found and caught in muddie places, but never without a companion, which they call pinnoter or pinnophylax. And it is no other but a little shrimpe, or in some places the smallest crab, which beareth the nacre companie, and waites upon him to get some victuals. The nature of the nacre is to gape wide, and sheweth unto the little fishes her seelie body without any eie at all. They come leaping by and bye close unto her, and seeing they have good leave, grow so hardie and bold as to skip into her shell and fill it ful. The shrimpe lying in spiall seeing this good time and opportunitie ginneth token thereof to the nacre secretly with a little pinch. She hath no sooner this signall but she shuts her mouth, and whatsoever was within, crushes and kills it presently, and then she divides the bootie with the little crab or shrimpe, her sentinell and companion." It is needless to add that the greater part of this, however entertaining, is purely fabulous, the fact of the two animals being found in such close companionship having apparently suggested the other circumstances to the lively imaginations of the narrator or his informants.

The Crustacea afford many beautiful microscopic objects, yet they seem to have received no attention from those who habitually prepare mountings for sale. The colouring matter of the integuments is often disposed in very beautiful stellate or arborescent forms, an excellent example of which is given in the accompanying plate (fig. 1). The drawing represents a portion of the tail of the common Opossum shrimp (*Mysis flexuosus*), so called from the young being carried about in a sort of pouch for some little time after being hatched. Most parts of the body exhibit some arrangement of pigment, but the quantity and colour of it is in this species very variable, hence one of its specific names, *Chameleon*. In all cases, however, there is one large stellate mark in the centre of the back of each abdominal segment.

Another peculiarity of this interesting genus is the presence in one of the outer laminæ of the tail of a conspicuous

* Aristotle, *History of Animals*, Bv. 8, 9. Creswell's translation.
† Pliny, *Nat. Hist.*, cap. 42. Holland's translation (1634).

circular organ, showing two or three concentric rings. This is found to be an auditory apparatus, consisting of a membrane analogous to a *membrana tympani*, which encloses a small quantity of fluid. An expansion of an auditory nerve lines the membrane, and is kept constantly bathed in the fluid, constituting a remarkable analogue to the "vestibule" of higher animals. The beautiful disposition of cilia round the *caudal lamellæ* is also well seen in this drawing. There is, indeed, scarcely any Crustacean which does not exhibit most exquisite arrangements of this kind. The scales of the hard-shelled species are well seen on the claw of the little *Galathea squamifera*, a not uncommon species on most of our rocky shores, and known in some places as the "Violet Crab." Fig. 2 gives a representation of a portion of a claw. Under the "binocular" microscope and with a low power of two or three inches it is a most beautiful object. A section of the shell of the common edible crab (*Cancer Pagurus*) is given in fig. 3. This is made parallel to the surface, exhibiting a structure remotely similar to the bone of more highly organized tribes. The antennæ, and the hairs which clothe almost every species, will be found interesting subjects of observation; and for those who desire more than mere passing amusement the development of the ova —not a difficult matter providing a plentiful supply of sea water can be had—will afford scope for many an interesting investigation.

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RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE KEW OBSERVATORY.

BY CHARLES CHAMBERS.

LATITUDE 51° 28′ 6″ N., LONGITUDE 0° 18′ 47″ W.

1862. Day of Month.	Reduced to mean of day. Barometer corrected to Temp. 32°.*	Temperature of Air.	Calculated. Dew Point.	Relative Humidity.	Tension of Vapour.	Temperature of Air. Maximum, read at 9·30 A.M. on the following day.	Minimum, read at 9·30 A.M.	Daily Range.	At 9·30 A.M., 2 P.M., and 5 P.M., respectively. Proportion of Sky clouded.	Direction of Wind.	Rain—read at 9·30 A.M.
	inches.	°	°		inch.	°	°	°			inches.
Oct. 1	30·121	54·7	45·1	·72	·315	61·0	41·6	19·4	1, 3, 3	W by N, WSW, SW.	·020
„ 2	30·138	58·9	57·4	·95	·479	63·7	50·5	13·2	10, 10, 10	SW, SSW, SW	·030
„ 3	30·311	62·5	57·4	·84	·479	68·0	58·9	9·1	10, 5, 1	SW by S, W, W.	·018
„ 4	30·434	57·9	56·5	·95	·465	62·0	48·0	14·0	10, 10, 10	—, —, —.	·007
„ 5	...	...	...	...	...	62·4	49·0	13·4	...	...	·000
„ 6	29·998	58·5	56·5	·93	·465	64·4	51·9	12·5	10, 10, 10	ENE, —, NW.	·000
„ 7	30·042	50·1	44·1	·81	·305	57·0	49·8	7·2	5, 10, 10	NNW, NW, N by E.	·000
„ 8	30·305	56·6	51·8	·85	·397	61·3	49·6	11·7	8, 9, 9	NE, NE, NE by N.	·150
„ 9	30·244	55·5	49·3	·81	·364	59·9	52·3	7·6	9, 3, 2	E by N, ENE, ENE.	·003
„ 10	30·054	59·1	56·1	·91	·459	66·0	46·5	19·5	7, 3, —	E by N, NE by E, —.	·000
„ 11	29·848	57·7	54·4	·89	·433	63·0	53·6	9·4	9, 8, 9	SW, SW by W, SW.	·608
„ 12	...	...	...	...	...	63·3	51·6	11·7	...	...	·147
„ 13	29·838	54·4	49·4	·84	·366	61·3	49·4	11·9	9, 10, 10	SW, W by S, SW by S.	·158
„ 14	29·855	60·4	57·1	·89	·475	67·3	53·1	14·2	9, 10, 2	SW, S by E, SW by S.	·043
„ 15	29·683	56·0	52·7	·89	·409	68·1	58·8	9·3	7, 10, 10	S, WNW, W.	·000
„ 16	30·034	51·3	42·8	·75	·291	57·3	46·5	10·8	1, 2, 1	SW by W, SW by W, SW.	·053
„ 17	29·587	51·4	42·9	·75	·292	57·2	47·1	10·1	10, 2, 10	SSW, WNW, SW by W.	·108
„ 18	29·493	44·7	43·6	·96	·299	50·0	42·8	7·2	10, 10, 8	SSW, —, N by W.	·077
„ 19	...	...	...	...	...	57·0	36·4	20·6	...	...	·700
„ 20	29·344	43·9	37·4	·80	·241	49·9	43·8	6·1	7, 7, 4	SW, SW, WSW.	·637
„ 21	29·770	48·3	39·2	·73	·257	55·4	40·9	14·5	10, 2, 4	WSW, NW byW, SW byW.	·003
„ 22	29·385	53·6	51·1	·92	·387	59·5	45·5	14·0	10, 8, 5	SW, W, SW by W.	·163
„ 23	29·280	48·6	41·4	·78	·277	53·9	44·8	9·1	4, 8, 10	SW, SW, SW.	·017
„ 24	29·697	44·7	38·2	·80	·248	51·4	38·3	13·1	0, 2, 5	WSW, W, SSW.	·010
„ 25	29·891	48·2	42·2	·81	·285	53·2	33·1	20·1	4, 10, 10	SW, SW, SSW.	·000
„ 26	...	...	...	...	...	55·3	45·4	9·9	...	...	·116
„ 27	29·901	51·0	47·1	·88	·338	55·4	40·2	15·2	10, 10, 6	SW by S, SSW, SW.	·008
„ 28	29·799	45·4	41·9	·89	·282	49·3	47·9	1·4	10, 10, 10	N by W, NW, N.	·038
„ 29	29·932	42·8	38·2	·85	·248	48·0	41·4	6·6	10, 8, 7	NNW, —, —.	·083
„ 30	29·836	41·4	37·7	·88	·244	50·0	27·0	23·0	10, 6, 4	—, ESE, E.	·000
„ 31	29·727	49·5	48·9	·98	·359	52·9	33·0	19·9	10, 10, 9	ESE, E, ESE.	·018
Monthly Means.	29·872	52·1	47·4	·85	·350	...	...	12·4	...	...	3·215

* To obtain the Barometric pressure at the sea-level these numbers must be increased by ·037 inch. This remark is applicable also to the Mean Daily Readings of the Barometer from January to September, 1862.

HOURLY MOVEMENT OF THE WIND (IN MILES) AS RECORDED BY ROBINSON'S ANEMOMETER.—Oct. 1862.

Day.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Hourly Means.
Hour. 12																																
1																																
2																																
3																																
4																																
5																																
6																																
7																																
8																																
9																																
10																																
11																																
12																																
A. M. 1	9	16	11	6	11	6	3	16	10	10	10	4	12	14	18	7	11	14	5	21	22	14	15	9	5	23	7	23	2	1	7	11·0
2	4	18	10	8	10	6	6	17	12	9	11	4	13	14	12	9	15	15	6	15	18	14	19	8	3	31	10	17	1	2	10	11·1
3	14	12	9	9	8	4	12	14	14	7	7	2	15	15	13	9	15	8	9	8	17	14	18	7	3	28	7	21	1	1	8	10·7
4	11	9	4	9	7	6	4	13	4	4	7	4	12	16	17	11	20	11	8	16	15	19	8	5	28	8	16	2	1	9	9	10·3
5	3	12	8	3	6	4	9	13	12	3	6	7	18	20	12	23	15	9	7	14	21	21	7	5	25	3	22	2	0	13	10	10·8
6	5	13	9	4	5	2	8	15	13	5	11	9	15	16	11	26	12	7	21	10	20	21	5	5	22	14	11	1	2	1	12	10·0
7	9	15	10	1	6	1	13	10	10	2	6	11	10	10	13	14	10	35	12	8	15	23	27	6	4	21	23	3	1	1	10	9·9
8	10	17	10	1	5	1	16	18	11	5	15	10	13	15	10	13	30	10	9	6	106	15	26	8	11	12	22	3	3	1	7	10·9
9	12	18	11	2	8	4	12	18	11	3	16	13	13	15	13	25	23	8	16	18	19	22	32	9	17	11	21	3	3	1	7	11·4
10	11	17	12	4	11	7	15	25	13	11	20	14	12	15	17	18	6	18	19	20	22	29	37	12	17	9	26	3	3	3	8	13·5
11	16	14	5	12	7	16	12	29	12	14	24	19	13	15	15	20	6	19	23	23	25	30	35	12	13	14	26	2	5	2	8	14·5
12	10	18	13	6	12	7	18	28	12	8	28	21	15	20	12	15	11	5	17	21	21	25	33	11	21	13	27	3	5	4	8	15·2
P. M. 1	11	17	11	2	19	2	14	12	25	7	8	26	16	19	12	14	14	3	16	19	21	21	29	11	22	13	25	3	4	4	7	14·0
2	8	13	12	2	15	5	12	17	11	20	10	12	25	16	19	12	9	16	9	15	20	21	27	12	21	13	20	5	5	6	9	14·8
3	8	10	10	1	5	2	11	20	10	6	10	8	26	16	19	14	17	9	15	16	19	15	25	3	20	7	26	2	5	5	8	13·3
4	7	8	9	1	4	5	5	12	10	9	10	10	13	8	14	8	15	15	15	16	17	20	23	6	23	7	20	2	0	5	5	12·0
5	10	11	8	1	11	3	21	11	24	10	11	19	13	4	5	7	17	7	26	13	8	15	17	6	26	7	24	4	0	11	7	11·2
6	10	10	6	1	12	3	19	12	18	6	9	12	8	15	5	9	15	7	32	14	8	15	16	5	27	6	27	2	1	7	8	11·8
7	9	7	6	1	12	3	22	9	13	7	6	13	12	15	6	14	9	18	36	11	16	14	4	4	26	9	28	3	1	7	4	11·4
8	8	7	7	1	15	4	22	9	13	7	6	13	12	15	6	11	15	7	37	14	7	15	12	6	28	6	23	4	0	7	3	11·0
9	11	11	10	2	10	6	19	10	8	14	5	15	11	19	7	10	13	10	38	18	14	13	10	5	28	9	27	5	1	6	3	11·6
10	11	10	7	4	6	4	16	10	11	4	13	10	16	7	11	13	7	9	22	18	7	14	10	5	23	8	25	3	1	2	2	10·7
11																																
12																																
Total Daily Movement.	194	317	230	78	247	113	333	299	416	183	194	361	294	339	250	250	467	230	406	380	354	533	528	175	368	358	472	174	44	97	176	11·9

RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE KEW OBSERVATORY.

LATITUDE 51° 28′ 6″ N., LONGITUDE 0° 18′ 47″ W.

1862. Day of Month.	Reduced to mean of day.					Temperature of Air.			At 9·30 A.M., 2 P.M., and 5 P.M., respectively.		Rain—read at 9·30 A.M.
	Barometer, corrected to Temp. 32°.*	Temperature of Air.	Calculated. Dew Point.	Relative Humidity.	Tension of Vapour.	Maximum, read at 9·30 A.M. on the following day.	Minimum, read at 9·30 A.M.	Daily Range.	Proportion of Sky clouded.	Direction of Wind.	
	inches.	°	°		inch.	°	°	°			inches.
Nov. 1	29·883	50·0	49·4	·98	·366	53·7	46·9	6·8	10, 10, 10	N, —, —.	·000
„ 2	...	...	...	...	...	53·7	49·0	4·7	...	... ...	·000
„ 3	30·061	49·9	47·9	·93	·347	55·3	39·7	15·6	10, 10, 3	WNW, S by E, SSE.	·000
„ 4	30·029	50·8	48·6	·93	·356	55·8	35·1	20·7	9, 9, 9	SSE, SSE, SSW.	·007
„ 5	30·061	44·8	45·1	1·00	·315	47·4	45·0	2·4	10, 10, 10	N, —, W by S.	·438
„ 6	30·119	38·1	39·0	1·00	·255	42·9	33·7	9·2	10, 10, 10	—, —, NE.	·105
„ 7	30·290	37·3	37·3	1·00	·240	41·0	34·9	6·1	10, 10, 10	NNW, NW by W, N by W.	·130
„ 8	30·258	39·9	37·5	·92	·242	46.0	28·4	17·6	8, 8, 10	SW, SW, SW by S.	·005
„ 9	..	...	...	...	...	52·3	35·4	16·9	...	... ...	·015
„ 10	29·394	39·3	36·1	·89	·230	46·7	39·5	7·2	7, 8, 1	SW by W, SW by S, SW by S.	·090
„ 11	29·558	35·7	30·6	·84	·189	41·9	26·2	15·7	3, 1, 1	SW by W, NNW, NW.	·040
„ 12	30·018	37·4	28·2	·72	·174	42·4	25·6	16·8	1, 0, 0	SSW, NNW, NNW.	·000
„ 13	30·051	32·2	31·6	·98	·196	39·3	24·1	15·2	10, 4, 6	SSW, —, —.	·000
„ 14	29·929	33·7	33·9	1·00	·213	37·3	22·5	14·8	10, 10, 10	N by E, NNW, NNW.	·000
„ 15	30·078	39·9	37·9	·93	·245	44·4	30·8	13·6	3, 10, 10	NNW, N, N by W.	·008
„ 16	...	...	...	...	...	45·7	37·7	8·0	...	... ...	·000
„ 17	30·386	40·6	36·2	.86	·231	45·3	35·6	9·7	0, 1, 1	N, NE by N, N by E.	·006
„ 18	30·315	39·3	33·4	·81	·209	43·7	33·2	10·5	10, 10, 10	NE, NE, NE by N.	·000
„ 19	30·151	38·0	27·0	·68	·167	41·2	37·5	3·7	10, 10, 10	NE, ENE, NE.	·000
„ 20	30·183	37·6	30·3	·77	·187	40·8	33·2	7·6	3, 10, 10	ENE, NE by N, NE by N.	.000
„ 21	30·155	37·5	37·2	·99	·239	40·8	34·3	6·5	10, 10, 10	WNW, WNW, N by W.	·000
„ 22	29·892	34·8	27·8	·78	·171	40·3	28·1	12·2	7, 4, 6	NW by N, N, NNW.	·010
„ 23	...	...	...	...	...	38·8	23·0	15·8	...	... ...	.000
„ 24	29·759	35·6	30·0	·82	·185	41·0	25·3	15·7	8, 1, 1	NE by E, NE by N, NNE.	·000
„ 25	29·670	36·4	31·7	·85	·197	39.7	32·6	7·1	7, 8, 5	NE by N, NE by N, NE.	·000
„ 26	29·546	37·8	36·4	·95	·.33	42·9	36·0	6·9	10, 10, 10	NW by N, NW by N. WNW.	·000
„ 27	29·572	41·3	38·6	·91	·252	46·7	28·2	18·5	10, 3, 3	WNW, WSW, SW.	·058
„ 28	29·777	41·6	40·1	·95	·265	49·6	30·6	19·0	3, 9, 10	S, S, SSE.	·003
„ 29	29·642	38·5	35·2	·89	·223	41·0	37·7	3·3	10, 10, 10	E by S, S by W, SSW.	·000
„ 30	...	...	...	...	...	42·7	31·5	11·2	...	... ...	·000
Monthly Means.	29·951	39·5	36·3	·90	·237	...	...	11·3	...	... ...	0·915

* To obtain the Barometric pressure at the sea-level these numbers must be increased by ·037 inch.

HOURLY MOVEMENT OF THE WIND (IN MILES) AS RECORDED BY ROBINSON'S ANEMOMETER.—Nov. 1862.

Day.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Hourly Means.
Hour.																																
12																																
1	A.M.	3	2	2	3	3	3	5	3	15	11	6	2	5	1	3	12	12	6	9	13	4	4	3	5	16	18				3	6·4
2	A.M.	5	2	4	1	10	3	7	4	15	11	4	5	4	1	2	16	15	5	13	16	3	6	4	4	17	17				2	7·3
3	A.M.	4	2	3	3	8	3	3	2	17	11	5	4	3	2	3	15	13	3	12	11	3	6	3	4	17	14				1	6·5
4	A.M.	5	0	4	4	7	2	4	2	19	10	3	3	3	2	5	17	11	4	15	12	3	6	4	7	18	15				2	6·9
5	A.M.	4	2	4	4	8	0	8	1	20	12	5	4	1	3	9	16	11	8	12	17	4	11	5	8	20	14	158	128	332	1	7·9
6	A.M.	4	1	2	4	6	1	3	1	18	12	1	2	2	1	10	15	11	7	15	16	6	8	4	7	19	15				1	7·1
7	A.M.	4	2	3	3	4	4	2	2	20	16	2	3	2	2	10	14	12	4	13	16	2	5	1	7	23	17				2	7·2
8	A.M.	4	2	5	4	2	1	3	4	25	17	1	2	2	1	11	15	13	6	14	17	3	5	4	3	22	13				3	7·5
9	A.M.	5	3	1	5	3	4	4	5	25	14	1	4	1	0	7	15	15	3	17	19	3	5	2	3	25	14				4	7·7
10	A.M.	10	2	1	3	7	4	4	4	28	18	1	3	1	2	8	15	15	7	19	20	1	4	3	7	25	16				4	8·6
11	A.M.	5	2	3	8	2	2	7	5	31	15	3	4	1	1	15	16	14	14	20	20	4	5	2	13	22				7	2	9·0
12	A.M.	3	4	5	11	1	4	8	5	25	18	4	6	4	2	15	17	16	14	21	29	3	10	2	15	28				5	3	10·3
1	P.M.	3	4	6	10	4	3	6	5	27	15	6	9	1	1	15	16	17	13	22	28	5	10	3	16	25				4	2	10·2
2	P.M.	1	5	9	8	2	2	5	6	33	16	8	12	0	1	17	15	16	17	22	19	6	11	6	16	25				3	2	10·5
3	P.M.	1	2	7	7	1	2	7	5	26	14	8	9	1	2	18	9	13	15	20	14	2	9	3	15	24				3	3	8·9
4	P.M.	6	3	9	6	2	4	6	9	20	10	5	7	3	3	18	5	10	12	18	13	5	8	1	15	20				4	1	8·3
5	P.M.	3	1	11	5	3	8	5	8	13	9	2	8	1	2	20	5	9	8	18	12	6	4	1	13	17				1	3	7·3
6	P.M.	2	3	7	5	4	4	1	7	6	9	1	5	1	3	15	5	11	9	19	11	4	6	4	10	17				2	2	6·4
7	P.M.	1	2	3	5	4	8	3	5	7	8	2	3	1	3	15	6	14	12	15	12	4	4	4	10	23				5	4	6·8
8	P.M.	1	2	3	3	4	9	2	9	10	9	3	5	1	2	17	4	9	12	15	8	2	7	7	10	24				3	1	6·7
9	P.M.	1	0	1	3	2	6	3	11	8	10	3	3	1	1	15	8	11	11	14	7	3	2	4	13	20				2	2	6·1
10	P.M.	1	1	6	1	1	5	3	15	8	7	2	3	2	2	15	10	8	13	11	3	4	4	4	12	25				2	2	6·3
11	P.M.	2	2	3	1	3	8	3	10	8	7	3	2	2	3	13	9	9	11	15	4	3	3	2	15	21				2	3	6·2
12	P.M.	2	1	1	2	3	5	4	13	11	8	3	3	1	4	12	11	3	9	13	3	2	4	2	15	19				4	7	6·1
Total Daily Movement.		80	50	103	109	94	95	106	141	435	287	82	111	44	45	288	286	288	223	382	340	85	147	78	243	512		818			60	7·7

Rain— read at 9·30 A.M.	inches.
	·000
	·000
	·000
	·007
	·438
	·105
	·130
	·005
	·015
	·090
	·040
	·000
	·000
	·000
	·008
	·000
	·006
	·000
	·000
	·000
	·000
	·010
	·000
	·000
	·000
	·000
	·068
	·008
	·000
	·000
	0·915

RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE KEW OBSERVATORY.

LATITUDE 51° 28′ 6″ N., LONGITUDE 0° 18′ 47″ W.

1862. Day of Month.	Reduced to mean of day.					Temperature of Air.			At 9·30 A.M.; 2 P.M.; and 5 P.M. respectively.		Rain-read at 9·30 A.M.
	Barometer corrected to Temp. 32°*	Temperature of Air.	Calculated. Dew Point.	Relative Humidity.	Tension of Vapour.	Maximum, read at 9·30 A.M. on the following day.	Minimum, read at 9.30 A.M.	Daily Range.	Proportion of Sky clouded.	Direction of Wind.	
	inches.	°	°		inch.	°	°	°			inches
Dec. 1	29·602	43·0	41·5	·95	·278	44·9	35·6	9·3	10, 10, 9	E, E, E.	·046
„ 2	29·567	41·7	38·0	·88	·216	46·3	35·1	11·2	3, 7, 9	ENE, ESE, E.	·010
„ 3	29·682	45·5	41·7	·88	·280	48·5	39·2	9·3	5, 9, 9	SE, E by S, E.	·000
„ 4	29·839	46·6	45·6	·97	·321	48·7	43·3	5·4	10, 10, 10	E by N, E by S, SE by S.	·047
„ 5	29·986	49·4	47·5	·93	·343	51·9	44·2	7·7	4, 10, 10	S by E, S by E, S by E.	·008
„ 6	29·910	52·9	51·7	·96	·395	55·1	48·8	6·3	10 10, 10	S by W, SSW, SSW.	·052
„ 7	...	..	...	...	...	54·4	47·0	7·4	...	...	·180
„ 8	30·086	42·2	31·7	·69	·197	43·9	40 8	3·1	1, 0, 0	WNW, W, W.	·164
„ 9	30·039	43·7	41·0	·91	·274	46·7	38·5	8·2	10, 10, 10	SW, SW, S by W.	·003
„ 10	29·793	48·5	41·8	·79	·281	52·9	41·5	11·4	3, 1, 0	W, W by S, W.	·328
„ 11	29·863	45·9	42·7	·89	·290	49·0	33·7	15·3	5, 10, 10	SSW, SSW, SW.	·010
„ 12	30·299	38·7	33·1	·82	·207	44·8	34·1	10·7	1, 8, 7	SW, WSW, SW.	·160
„ 13	29·969	44·4	43·3	·96	·296	46·8	33·8	13·0	10, 9, 1	SW, SW by W, W by S.	·033
„ 14	...	...	...	...	...	43·3	29·9	13·4	...	...	·090
„ 15	30·377	40·0	35·9	·87	·229	42·9	27·1	15·8	10, 9, 8	S by E, S by W, S by W.	·000
„ 16	30·336	42·5	39·6	·90	·260	44·4	34·1	10·3	10, 10, 10	SW, SW, SSW.	·000
„ 17	30·278	45·6	43·6	·93	·299	51·2	40·1	11·1	10, 10, 10	SW, N by W, NW.	·000
„ 18	30·189	43 5	42·0	·95	283	45·4	31·7	13·7	10, 10, 10	SW, SW, SSW.	·090
„ 19	29·765	46·7	38·1	·74	·247	49·1	41·1	8·0	7, 8, 6	WNW, W, W by S.	·030
„ 20	29 560	41·4	30·8	·69	.191	43·7	37·2	6·5	2, 10, 10	SW by W, NW by W, NW by W	·000
„ 21	...	...	...	...	..	41·5	35·5	6·0	...	...	·000
„ 22	30·164	36·2	31·6	·85	·196	38·6	34·0	4·6	8, 10, 10	NNW, NW by W, NW by W.	·000
„ 23	30·086	43 3	42·7	·98	·290	45·9	34·0	11·9	10, 10, 10	SW, SW by S, N.	·122
„ 24	30·255	43·1	40·6	·92	·270	45·3	33·9	11·4	10, 10, 10	SW, WSW, SW.	·008
„ 25	...	...	...	...	...	49 4	41·9	7·5	...	...	·003
„ 26	30·296	46·8	39·5	·78	·260	49·0	38·8	10·2	10, 10, 10	WSW, W, SW by W.	·000
„ 27	30·365	45·4	44·1	·96	·305	49·9	36·8	13·1	10, 8, 10	—, SW, SW.	·000
„ 28	...	...	...	...	...	50·4	39·1	11·3	...	...	·000
„ 29	29·482	46·8	43·9	·90	·303	49·2	45·1	4·1	10, 8, 10	S by W, SW by S, WSW.	·020
„ 30	29·515	41·3	37·2	·87	·239	45·3	37·1	8·2	1, 4, 7	SW by W, W by S, W by N.	·165
„ 31	30·162	38·7	35·3	·89	·224	44·6	32·8	11·8	0, 3, 10	SW, WSW, SW by S.	·008
Monthly Means.	29·979	44·0	40·2	·88	·269	...	...	9·6	...	...	1·577

* To obtain the Barometric pressure at the sea-level these numbers must be increased by ·037 inch.

HOURLY MOVEMENT OF THE WIND (IN MILES) AS RECORDED BY ROBINSON'S ANEMOMETER—DEC. 1862.

Day.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Hourly Means.
Hour.																																
12	8	15	11	9	6		14	12	12	6	10	9	4	4	2	4	15	5	27	25	22	26	10	3	12	18	9	20	19	15	10	12·1
1	5	12	11	12	4		17	12	10	7	10	14	7	5	4	7	17	6	28	25	23	22	7	4	14	14	7	17	19	10	12	12·4
2	4	14	9	14	3		21	10	9	8	7	13	5	1	2	8	18	6	28	26	22	18	8	4	14	18	3	18	19	6	10	11·9
3	3	11	12	11	5		20	11	8	8	8	17	6	2	1	8	18	5	28	30	20	19	7	3	13	20	3	17	22	6	5	11·9
4	8	15	10	10	6	435	19	14	10	20	2	11	20	6	7	5	19	7	32	27	20	16	4	5	9	20	4	17	22	5	5	12·5
5	8	13	13	9	6		18	15	11	20	5	7	24	6	5	5	24	8	31	31	21	12	2	3	13	19	6	19	25	6	5	12·8
6	9	13	16	7	8		13	16	8	15	4	8	27	5	5	6	24	8	31	31	21	13	3	3	13	19	6	19	25	6	5	12·8
7	8	15	16	8	8		12	12	6	13	5	8	23	5	7	5	21	8	28	29	22	10	4	3	10	24	4	15	30	6	7	13·3
8	10	14	18	11	11		19	12	9	14	12	13	25	5	5	8	21	5	26	26	25	14	2	4	7	20	3	16	29	5	7	12·7
9	10	19	18	10	17		20	18	9	16	12	17	23	5	5	8	21	6	27	25	26	13	3	6	8	21	1	17	28	4	4	13·8
10	17	19	18	10			18	18	9	21	12	18	22	5	5	7	21	6	25	26	26	17	3	6	8	22	2	21	23	5	7	14·5
11	14	17	16	8			14	12	9	20	12	20	23	6	7	12	20	6	27	30	30	13	5	5	12	21	6	20	18	10	8	14·7
12	17	15	18	8			15	12	13	21	13	22	22	7	8	12	20	6	27	30	30	12	4	6	14	24	9	23	24	11	9	15·8
1	21	12	17	7			13	13	10	19	14	16	22	8	12	9	16	7	28	32	31	11	5	7	13	25	9	21	25	13	9	15·3
2	21	9	18	7			9	8	8	15	16	18	23	8	12	7	17	11	23	33	32	3	6	7	9	16	11	16	23	12	8	13·8
3	16	7	22	6			12	9	7	11	16	19	25	5	11	7	18	7	24	33	32	10	7	7	9	15	10	14	22	12	6	12·5
4	21	9	20	7			12	9	7	12	7	16	25	5	10	6	21	8	24	28	29	8	8	8	9	11	12	17	15	12	7	11·9
5	13	7	22	7			12	9	7	12	6	14	25	5	12	6	17	8	21	26	26	6	7	9	12	16	13	22	13	10	8	11·3
6	21	5	17	7			11	7	8	11	7	12	24	5	11	7	19	8	23	25	25	5	6	9	11	17	15	20	15	10	12	11·7
7	12	10	17	5			14	11	7	14	6	9	23	5	11	7	16	8	18	27	26	5	4	10	9	17	20	15	10	12	10	11·7
8	13	10	16	6			16	13	8	14	5	9	24	5	12	6	17	8	19	25	26	6	6	12	8	13	11	14	14	10	16	11·7
9	15	10	15	6			17	18	8	15	6	8	24	5	12	6	14	8	21	25	26	7	3	13	9	11	16	14	7	13	10	11·8
10	15	10	16	6			20	16	8	16	7	10	23	5	14	4	20	8	21	25	26	6	3	13	9	11	16	14	7	13	10	11·3
11	13	11	11	6			21	16	8	18	7	10	23	5	14	4	20	8	21	25	26	6	3	13	9	11	16	14	7	13	10	11·3
12	13	7	9	4			18	15	9	18	7	10	23	5	14	4	20	8	21	25	26	6	3	13	9	11	16	14	7	13	10	11·3
Total Daily Movement.	301	287	359	195	837	435	323	352	278	322	217	177	354	109	146	226	335	331	597	630	612	286	114	108	258	424	214	420	471	229	225	13·1

P.M. A.M. P.M.

Rain-read at 9·30 A.M.

inches
·046
·010
·000
·047
·008
·052
·180
·164
·003
·328
·010
·160
·033
·090
·000
·000
·000
·090
·030
·000
·000
·000
·122
·008
·003
·000
·000
·000
·020
·165
·008

1·577

TABLE SHOWING THE MEAN VELOCITY OF THE WIND FOR EACH HOUR OF THE DAY IN THE DIFFERENT MONTHS OF THE YEAR 1862 (IN MILES PER HOUR).

	A. M.												P. M.												
Hour.	12 to 1	to 2	to 3	to 4	to 5	to 6	to 7	to 8	to 9	to 10	to 11	to 12	to 1	to 2	to 3	to 4	to 5	to 6	to 7	to 8	to 9	to 10	to 11	to 12	Mean.
Jan. ...	10·8	11·1	11·4	11·2	11·5	11·0	11·1	10·8	11·2	12·0	12·2	13·6	14·7	14·1	12·9	12·1	11·3	10·4	10·9	11·0	10·5	10·7	11·3	10·5	11·5
Feb. ...	11·8	11·7	13·1	12·2	13·0	12·1	11·9	11·8	13·3	14·8	15·3	16·4	17·2	16·1	16·1	15·7	14·5	12·2	12·3	12·4	11·3	11·5	12·7	10·4	13.1
March	10·4	9·6	9·8	10·3	9·6	9·0	9·6	10·9	11·7	12·2	13.7	14·0	13·2	13·5	14·2	14·5	14·3	12·8	13·7	13·5	12·8	12·3	11·5	9·8	12·1
April	9·1	9·0	8·2	8·5	8·9	9·2	10·4	12·8	13·6	14·6	15·3	16·8	16·8	17·3	17·1	16·5	16·5	14·7	12·8	12·3	11·5	11·0	11·2	10·1	12·7
May ...	8·4	7·5	7·7	7·9	8·5	7·4	9·4	11·0	11·2	11·7	11·2	12·5	12·8	13·2	13·2	13·0	13·4	12·4	11·5	10·0	9·3	9·6	9·5	8·3	9·7
June...	7·8	8·5	8·0	7·5	8·2	9·1	10·1	11·7	13·1	12·9	13·9	14·3	14·8	14·6	14·7	14·4	14·0	12·2	11·5	10·0	9·0	8·7	9·7	7·9	11·1
July ...	8·1	7·8	8·0	8·8	8·9	9·1	11·0	12·6	13·4	13·1	14·4	14·9	15·7	15·7	15·5	14·6	14·4	12·5	11·5	9·7	8·8	8·3	9·2	7·9	11·1
August	6·0	5·7	5·7	5.4	5·6	5·9	6·9	8·8	9·9	10·5	10·7	11·1	12·2	12·1	11·8	11·5	11·2	9·5	8·0	7·8	7·3	7·0	6·5	5·9	8·5
Sept. .	5·7	6·1	5·3	5·7	5·9	5·9	6·3	7·7	9·5	10·6	12·1	12·4	11·9	12·2	11·8	11·3	10·9	9·6	8·5	7·8	7·6	7·0	7·0	6·0	8·5
Oct. ...	11·0	11·1	10·7	10·3	10·8	10·0	9·6	9·9	10·9	11·4	13·5	14·5	15·2	14·8	14·0	13·3	12·0	11·2	11·8	11·4	11·2	11·0	11·6	10·7	11.9
Nov....	6·4	7·3	6·5	6·9	7·9	7·1	7·2	7·5	7·7	8·6	9·0	10·3	10·2	10·5	8·9	8·3	7·3	6·4	6·8	6·7	6·1	6·3	6·2	6·1	7·7
Dec ...	12·1	12.4	11·9	11·9	13·0	12·5	12·8	13·3	12·7	13·8	14·5	14·7	15·8	15·3	13·8	12·5	11·9	11·3	11·7	11·7	11·8	11·3	13·1	11·6	13·1
Mean	9·0	9·0	8·9	8·9	9·3	9·0	9·7	10·7	11·5	12·2	13·0	13·8	14·2	14·1	13·7	13·1	12·6	11·3	10·9	10·4	9·8	9·6	10·0	8·8	10·9

RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE KEW OBSERVATORY.

LATITUDE 51° 28′ 6″ N., LONGITUDE 0° 18′ 47″ W.

MONTHLY AND ANNUAL MEANS FOR THE YEAR 1862.

Month.	Barometer, corrected to Temp. 32.°	Temperature of Air.	Dew Point.	Relative Humidity.	Tension of Vapour.	Daily Range.	Total Fall of Rain.	Month.	Barometer, corrected to Temp. 32.°	Temperature of Air.	Dew Point.	Relative Humidity.	Tension of Vapour.	Daily Range.	Total Fall of Rain.
	inches.	°	°		inch.	°	inches.		inches.	°	°		inch.	°	inches.
January	29·810	39·7	36·8	.87	·240	9·1	1·637	August ...	29·905	59·4	51·1	·76	·389	15·8	2·692
February.....	30·027	41·2	36·3	·84	·210	7·3	0·411	September	29·994	57·1	50·5	·81	·384	14·7	2·597
March	29·638	43·2	39·4	·88	·269	10·3	4·472	October	29·872	52·1	47·4	·85	·350	12·4	3·215
April	29·980	47·5	40·5	·80	·278	12·7	2·575	November.	29·951	39·5	36·3	·90	·237	11·3	0·915
May.....	29·854	53·9	47·5	·82	·349	15·1	3·775	December.	29·979	44·0	40·2	·88	·269	9·6	1·577
June	29·850	53·5	46·7	·80	·336	15·1	2·366								
July	29·907	58·3	50·1	·77	·378	15·8	2·057	Mean	29·900	49·1	43·6	·83	·310	12·4	28·289

* To obtain the Barometric pressure at the sea-level these numbers must be increased by ·037 inch.

URANUS.—DOUBLE STARS.—OCCULTATIONS.

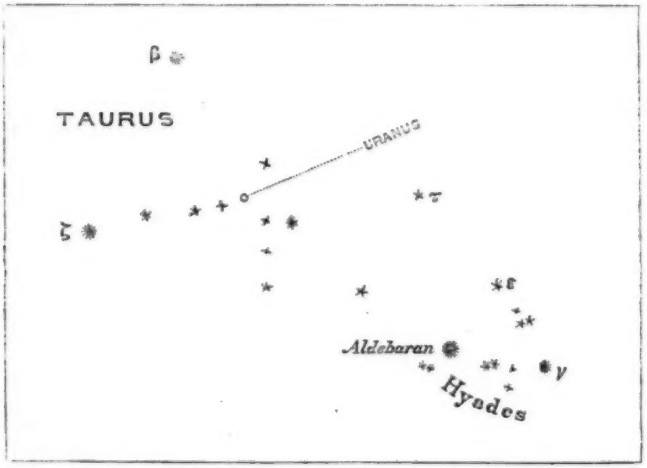
BY THE REV. T. W. WEBB, F.R.A.S.

URANUS.

A VERY minute lucid speck, barely distinguishable in the dark midnight, is the only indication of the presence of what may be fairly deemed one of the most important members of our system —a magnificent globe, nearly four and a-half times the diameter of the earth, and attended by a numerous retinue of satellites. Such is the result of its amazing distance, 1646 millions of miles at its nearest approach in *perihelio* and opposition; and hence, as a popular object, it has never attracted much attention. Eighty-two years are nearly completed since it has been recognized as a planet (for as a fixed star it had been observed by Flamsteed in 1690, if not by Tycho Brahe as far back as 1587); and yet to many possessors of telescopes quite competent to show it fairly, it is wholly unknown. It must indeed be admitted that there is not much to be made of it with ordinary optical means; but still the earnest student will not be satisfied with its omission, nor would he wish to lose the opportunity thus afforded him of gaining a fresh idea of the stupendous magnitude of the solar system, so impressively indicated by the diminutive aspect of this majestic planet. Under favourable circumstances it is perceptible with the naked eye; Smyth tells us that it appears as a star of the 6th or even 5th magnitude; I have seen it quite distinctly as a very minute but sharp and steady point; and it is of course sufficiently conspicuous even in the most ordinary telescope. I have not made the trial what amount of aperture would suffice to exhibit it as a planetary disc; but since its apparent diameter never varies much from 4″, no very small instruments can be expected to reach it; yet even in these there may be a possibility of recognizing it by its steady and quiet light, very dissimilar to the sparkling and vivid aspect of a star of corresponding magnitude. Sir W. Herschel discovered its visible disc in 1781 while using a power of 227 applied to a 7 feet reflector with a 6·3 inch speculum; but a much smaller magnifier is capable of showing it, especially to those who know what to expect; for, according to a remark of his own, "when an object is once discovered by a superior power, an inferior one will suffice to see it afterwards." With a $3\frac{7}{10}$ inch object-glass I found the disc perceptible with a power of 144, and much dilated with 250; my present $5\frac{1}{2}$ inch achromatic just shows it with 55, and defines it very fairly with 170, and even 460. Once I had the pleasure of seeing it as a beautiful miniature full moon, with an 11 feet achroma-

tic of 7 inches aperture, considered the *chef-d'œuvre* of the late George Dollond, at that time the property of H. Lawson, Esq., of Bath, and subsequently bequeathed by him to the Greenwich Naval School.

During the present season Uranus will be found a little beneath a line joining Aldebaran and β Tauri, about one-third of the distance from the latter star, the position of which is specified in our list of Double Stars, No. 74. For the convenience of the student a diagram is subjoined, which, with



little pretension to accuracy, may prove of use in the search. Excepting Aldebaran and the Hyades, and β and ζ Tauri, the stars are barely visible to the naked eye, and unfortunately not dissimilar in magnitude to the planet; a tolerably high power should therefore be used in looking for it, sufficient to identify it by "raising" an obvious disc at first sight.

DOUBLE STARS.

During the last and the present month our evening skies develope their greatest brilliancy. Orion, the matchless Orion, in his golden armour,* illuminates the meridian; Sirius, the magnificent leader of the starry host, blazes out a little below him to the left, with his attendants in Canis Major towards the S. horizon; the beautiful clusters of Taurus are only beginning to decline towards the W.; on the other side of the meridian are the heads of the Twins, a conspicuous pair; while Capella,

* Armatumque auro circumspicit Oriona.—VIRGIL.

the rival of Wega, and to some eyes its superior, occupies the region of the zenith. We should wait in vain for a more perfect combination of stellar beauty and grandeur.

The *Pleiades* surely will require no guide. This beautiful group in which, notwithstanding the ancient idea of a "lost Pleiad," some eyes still descry a seventh star* (though mine will not), is so generally known that it can scarcely be necessary to point it out somewhat W. of the meridian about 7h. at the beginning of the month. The principal star, *Alcyone*, also known as *η Tauri*, was brought into considerable notice, some years ago, by a speculation of Mädler, that it was the "central sun," or, more correctly speaking, was the nearest luminous body to the common centre of gravity, about which the visible universe is slowly revolving; the idea, however, seems to be now abandoned, as having been based on inadequate data. Novices often express a wish to look at the Pleiades through a telescope; but notwithstanding their promise to the unaided eye, they prove a disappointing picture as a group, lying too widely scattered for the compass of any ordinary field; in detail, however, they contain some pleasing and remarkable combinations, especially a beautiful little triangle close to Alcyone; a neat pair at some distance from this object *n.p.* may also be mentioned, and a curious crooked row of small stars *s.* of the *lucida*. Their neighbours the *Hyades* contain several attractions for the student. These are easily recognized, lying a little to the left of the Pleiades, and somewhat beneath them, in the form of a flight of wild-geese, or of the letter V turned upon its side with its point to the west; this is occupied by the star *γ Tauri*, 3 mag.; at the E. end of the lower stroke of the letter stands *a Tauri*, a conspicuous red star; at the corresponding termination of the upper stroke is *ε*. Our list begins with the ruddy star—

70. *a Tauri, Aldebaran.* 1′ 47″·9. 35°·9. 1 and 12. Pale rose tint and sky-blue. The magnitude of the attendant has been assigned by Smyth on deliberate comparison: he saw it, however, readily with $3\frac{3}{4}$ inches of aperture, as Dawes has done with an inch less; few astronomers, however, possess such an eye as the latter observer. I have seen it distinctly with $3\frac{7}{10}$ inches, but not without considerable attention; it is a good test of the instrument and the sight: in this respect resembling *Wega*, striking as is the dissimilarity of its hue. W. Struve has thought it not impossible, from traces of common spatial motion, that this may be a physically connected system; if so, the remarks on No. 25 of our list would be strikingly exemplified.

In the midst of the lower line of the V, the unaided eye

* Möstlin, the tutor of Kepler, is said by the latter to have seen fourteen stars there without a telescope. A valued correspondent of mine has perceived eight.

will readily detect a pair somewhat like *a Capricorni*, though of less magnitude. This is—

71. θ^1 and θ^2 *Tauri*. 5′ 36″·8. 166°·7. 5 and 5¼. Pearly white and yellowish. A common proper motion is suspected; according to W. Struve, more than suspected: should this be verified, we behold here a glorious system, whose magnitude and wide separation seem sufficiently to bespeak its comparative nearness to our earth. It ought to show an appreciable parallax; but I am not aware that any attempts have been made to detect it; meanwhile, it is worthy of remark that, though a large spatial motion naturally introduces a suspicion of proximity, its absence is no indication to the contrary, as a great amount of displacement may be concealed by its direction relatively to our sight. These stars form a noble object in almost any telescope, especially if the field is large.

At no great distance is another grand pair, very similar in character, though not quite of equal magnitude; it will be found by a line from θ through ϵ; this points to a group of small stars, the nearest of which are—

72. κ^1 and κ^2 *Tauri*. Not in the Bedford Catalogue, but according to W. Struve's data, 5′ 39″·28. 5 and 6. Yellowish white and white. This double star is remarkable not only from its striking telescopic aspect, and its similarity to θ, but from the intervention of a very pretty minute pair, 10 or 11 mag., between the components; a curious copy, on a very reduced scale, of its mightier neighbours.

A third object of the same class is to be found, singularly enough, in the same neighbourhood, so near as to lead to the impression that something more than optical juxtaposition may probably be concerned in the arrangement, especially as other large pairs, wider than these three, occur within the compass of a few degrees. Immediately *s.f. Aldebaran*, we shall find—

73. σ^1 and σ^2 *Tauri*. Not catalogued by Smyth; 5·2 and 5·7 according to W. Struve's notation; but, like κ^1 and κ^2, much fainter than θ^1 and θ^2 to the naked eye. White.

A line through γ and ϵ, at an equal distance, falls upon

74. τ *Tauri*. 61″·6. 209°·8. 5 and 8. Bluish white and lilac; a pretty, though wide object.

A line from *Capella*, or *a Aurigæ*, now reigning supreme near the zenith, down to the three stars which almost every one recognizes as the *Belt of Orion*, will pass, before reaching the middle distance, a solitary 2 mag. star. This is β *Tauri*, the Bull's N. horn, the S. being marked by a less conspicuous star, ζ, 3 mag., 8′ below it, a little to the left. A line from β to the *Pleiades* passes, nearly where crossed by another, through ϵ and κ *Tauri*, between two very minute stars, each worth examination. The uppermost is—

75. ϕ *Tauri.* 55″·9. 241°·8. 6 and 8½. Light red and cerulean blue. This will be found a striking contrast of colours.

The lowermost star is—

76. χ *Tauri.* 19″·3. 25°·1. 6 and 8. White and grey.

Between this and the group containing κ, is a pretty object, invisible to the naked eye, and therefore smaller than any that were considered eligible for this list; it is, however, so easily found with the telescope from its position, that I am induced to insert it:—

77. 62 *Tauri.* 28″·6. 290°. 7 and 8½. White and pale purple.

Our acquaintance with the *Hyades* has led us to linger in their neighbourhood; but we must return to catch some objects declining so rapidly to the west, that the earliest opportunity must be taken of looking for them.

If we continue the left side of the square of *Pegasus* downwards about half as far again, it will fall on a little group of inconsiderable stars; the preceding of these is—

78. 35 *Piscium.* 11″·9. 149°·5. 6 and 8. White and purplish.

Two lines, one from β *Andromedæ* (see No. 64) through the middle of the head of *Aries*, the other from *Capella* passing a little beneath the *Pleiades*, meet near a considerable 2 mag. star, the largest of its vicinity, α *Ceti*, *Menkab*, or *Menkar*, worth looking at for its beautiful orange hue, as well as the fine blue tint of a 5½ mag. star just *n.* of it. It lies in the jaw of the *Whale*, a huge constellation stretching far away to the S.W., its second star, β, being the brightest near the horizon in that direction. The next star, *p. a.* a little *s.*, is—

79. γ *Ceti.* 2″·6. 285°·7. 3 and 7. Pale yellow and lucid blue (I thought the small star tawny, 1850 9). A fine pair, and a good test for a small telescope. W. Struve gives it common proper motion.

The largest star near a line drawnfrom α through γ Ceti is—

80. α *Piscium.* 3″·8. 333°·4. 5 and 6. Greenish and pale blue. An orbital revolution appears to be demonstrated here. There seems to be something very peculiar in the colour of the smaller star, as to which observers are strangely at variance with each other, and even with themselves. Some see no contrast, some agree with Smyth, some find it tawny or ruddy. The details are curious, but too long for insertion here. Other small stars show a similar uncertainty, which, as it refers to complementary colours, may perhaps depend upon the condition of the retina. That real variations, however, do exist, was long ago suspected by Herschel II. and South, and is still supposed by Secchi.

Near a line from α *Piscium* to the large star β (*Deneb Kaitos*)

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in the tail of *Cetus* (see No. 78), we shall find two 3 mag. stars, θ and η *Ceti*. A little way *p.* θ (the nearer of the two to α *Piscium*) is our next object, which ought to be looked for very early in the evening and in the month, or may perhaps, like some others in this list, have to be reserved for another season—

81. 37 *Ceti*. 50″·6. 332°·3. 6 and 7½. White and light blue. This fine pair, to which W. Struve ascribes common proper motion, is attended by a smaller and closer one, *n.*, a little *p.*, arranged in a not dissimilar way, its data being 20″·5. 341°·1. 8 and 10. Yellow and violet. The whole combination is a very pretty one, but requires the extended field of a low power.

Somewhat below the centre of a line from α *Piscium* to γ *Pegasi* we shall find a small 4 mag. star, ϵ *Piscium*. The next star visible to the naked eye *f.* this, is—

82. ζ *Piscium*. 23″·4. 63°·8. 6 and 8. White and greyish. Smyth says that the larger star may possibly be variable, 4 to 6 mag. W. Struve finds common spatial motion.

If we now join α *Andromedæ* and γ *Arietis* (No. 68) the line will pass a little above two small stars, lying nearly parallel to it. The one nearly under its centre is η *Andromedæ*, 5 mag.; the other, further *n. p.*, is ζ, 4 mag. (so rated in the S. D. U. K. Star Maps, though they differ little to the eye). Between ζ and η, but nearer η, is—

83. 36 *Andromedæ*. 1″ (1843·12). 322°·9. 6 and 7. Bright orange and yellow. The evident motion of this interesting pair has so widened it as to render it an excellent test for moderate-sized instruments. I was surprised at being able to elongate it with 144 of $3\frac{7}{16}$ inches, 1850·87; there is at present a strong black division with 170 of 5½ inches. George Knott, Esq., of Woodcroft, Cuckfield, to whom I am indebted for much valuable information, has recently obliged me by repeatedly measuring it with his 7½-inch Alvan Clark equatorial, and gives as his mean *approximate* result, to which, however, he does not attach great weight, 1″·246. The angle, also, according to Secchi in 1857, has been rapidly increasing.

A line from ζ through η *Andromedæ* points somewhat above a group of little stars; the nearest of these to η is—

84. ψ^1 *Piscium*. 30″·2. 160°·4. Both 5½. Flushed white and pale white. A third minute star lies *s. f.* from this noble object.

The 3 mag. star lying between α and β *Andromedæ*, a little below the line, is δ *Andromedæ*. If we join this star and η we shall find, a little to the left of the line in mid-distance—

85. 65 *Piscium*. 4″·5. 298°·5. 6 and 7. Both pale yellow. Smyth thinks this remarkably neat pair may be in slow orbital

motion, which, however, has not been confirmed by the recent observations of Secchi. Nor is the inequality of magnitude apparent. W. Struve made them both 6 mag., 1832·13, the *p.* star perhaps very slightly the smaller. I found them very nearly equal, 1850·01, 1855·85, 1862·89.

A line through γ and β *Trianguli* (see No. 69) carried almost twice as far again, points nearly to—

86. 56 *Andromedæ*. 2′ 56″·2. 302°·4. Both 6, and both yellow. The interest of this wide pair is derived from its common motion through space.

Between γ *Andromedæ* and γ *Trianguli*, one-third of the distance from the former, is a very minute star, having another somewhat brighter *s.* of it, in the line between γ *Andromedæ* and β *Trianguli*. The smaller star is—

87. 59 *Andromedæ*. 16″·3. 34°·7. 6 and 7½. Bluish white and pale violet. A fine stationary pair.

The lovely brilliant some way beneath the three stars in the Belt of Orion, and a little in advance, is *Rigel*, β *Orionis*, in the giant's foot. A line from this star to γ *Ceti* passes, in mid-distance, a small object, which must be searched for with the telescope, for want of means of identification; as, however, the neighbourhood is not rich in stars, it will not give much trouble. It is a very beautiful pair:—

88. 32 *Eridani*. 6″·6. 346°·5. 5 and 7. Bright yellow and flushed blue; in brilliant contrast. Secchi calls its colours "magnifici" and "superbi." No motion has been perceived in it.

We must now attack the most glorious of constellations, and one of the richest in remarkable objects of all kinds, beginning with the belt, as so generally known. The uppermost or leader of these three stars is—

89. δ *Orionis*. 53″·2. 359°·9. 2 and 7. Pale white and flushed white. A beautiful pair, very nearly on the equator, and therefore well calculated for measuring telescopic fields by its passage. The lowermost, or hindermost, is—

90. ζ *Orionis*. 2″·5. 148°·8. 3 and 6½. Yellow and flushed blue. This is a well-known and excellent test, more severe, in consequence of the magnitude of the large star, than is indicated by its mere distance. I have just divided it with 80 and a $3\frac{7}{10}$-inch aperture. It is very strange that the lynx eye of Herschel I. should have overlooked the small star, which was reserved for Kunowsky about 1821. It is either stationary, or, as Secchi thinks, in very slow angular motion. A third 10 mag. star lies at 56″ and 7°·8. I have seen the *comites* of this and the last object oscillate like pendulums, as described under No. 65. Just beneath ζ, a little *p.*, is—

91. σ *Orionis*, a multiple star, consisting of two groups of

four stars each, with two exceedingly minute, or, as Barlow very ambiguously called them, "*fine*," stars between them. It is, on this account, a good test for sight; all the stars have been seen, though one of the intermediate ones only by glimpses, with a $3\frac{7}{10}$-inch object-glass, by Cooke. The minute star *p.* the *lucida* was somehow missed by the two Herschels and South, and discovered by Dawes in 1829; yet it is now not a difficult object, being 11 mag. and 12″ distant from its 4 mag. neighbour; and it has been perceived with only $3\frac{1}{4}$ inches of aperture, so that there is some suspicion of variability.

Beneath the *belt* hangs the *sword* of *Orion*, a group of small stars with a brighter one at the bottom; this latter is—

92. *ι Orionis.* 11″·5. 141°·7. $3\frac{1}{2}$ and $8\frac{1}{2}$. White and pale blue; the smaller star perhaps variable. This beautiful pair has an 11 mag. companion at 48″·9 and 102°·8, and lies in a glorious low-power field, which contains a misty glow, indicating the presence of an outlying portion, as large instruments reveal to us, of the grand nebula. The Earl of Rosse's speculum, however, exhibits the triple group encompassed by a singular intervening patch of darkness. Just above this is—

93. *θ*[1] *Orionis*, a quadruple group, known as "the trapezium," and lying in the heart of one of the most wonderful and mysterious objects in the universe, the—

Great nebula of Orion. Of this our readers may expect, some future day, a more detailed account than our space will now admit. In the meantime let them try to accustom their eyes, as far as their telescopes will aid them, to its marvellous construction and extent. The quadruple group is shown to be physically connected, from its joint spatial motion; it contains two more very minute stars, which are admirable telescopic tests. The fifth, discovered by W. Struve, has been seen by Dawes with a 5-feet achromatic, and is sufficiently evident with my $5\frac{1}{2}$-inch aperture; the sixth is considerably fainter, a very trying criterion of excellence; it has been perceived, however, with one of Lassell's 9-inch specula. The colours of the four principal stars are given as pale white, faint lilac, garnet, and reddish.

94. *β Orionis, Rigel.* 9″·5. 199°·4. 1 and 9. Pale yellow and sapphire blue. The position of this splendid object has been described after No. 87. Smyth thought it merely optical, but Secchi finds movement. It has been long known as a test, but instruments even of moderate size have left it behind in modern days, and it has the disadvantage of being low. Dawes has seen it, as well as the companion of *Polaris*, with a 2-feet Dollond, aperture $1\frac{6}{10}$-inch, power 70.

The stars of the belt point *n. p.* at a few degrees distance to—

95. ρ^1 *Orionis.* 6″·8. 61°·8. 5 and 8½. Orange and smalt blue. Probably fixed. 1849·11, 1856·19, I thought the *comes* much smaller than its assigned magnitude.

The next star *s.* of γ, a very little *p.*, is—

96. 23 *Orionis.* 32″·3. 27°·9. 5 and 7. Creamy white and light blue. W. Struve makes them greenish white and white, a solitary instance of such a combination. *s. f.* from this, close at hand, lies ψ^3, and this is followed, slightly *n.*, by—

97. 33 *Orionis.* 2″. 25°·8. 6 and 8. White and pale blue. A beautiful pair.

In a line from Betelgeuse to 23 *Orionis*, 2° from the former, and just visible to the naked eye in a transparent night, we find—

98. 52 *Orionis.* 1″·8. 199°·9. 6 and 6½. Pale white and yellowish. Smyth calls this very neat pair stationary; but W. Struve gives it a common proper motion. It forms an excellent test, from its permanence in distance. I have seen it nicely divided with 144 of $3\frac{7}{10}$-inches.

Above the two shoulders of *Orion* is the *head*, a group of small stars; the uppermost of these is—

99. λ *Orionis.* 4″·5. 43°. 4 and 6. Pale yellow and purplish. Stationary. The field is very fine. 5½ inches show me a very minute *comes* at a little distance, not in Smyth, but in Struve and Secchi.

We take one more object, as from its S. declination it will soon be lost. *s.* of *Rigel*, a very little *p.*, are two small stars, one beneath the other; the lowermost is—

100. κ *Leporis.* 3″·7. 359°·5. 5 and 9. Pale white and clear grey.

OCCULTATIONS.

During the present month there will be only two occultations of considerable stars by the moon at convenient hours. Feb. 6th, *e* Leonis, 5 mag., will be hidden at Greenwich from 9h. 9m. to 9h. 26m. Feb. 27th, 15 Geminorum, 6 mag., from 9h. 45m. to 11h. It will be better to insert here, for the convenience of some readers, one on March 1st, when 5 Cancri, 6 mag., will disappear at 5h. 41m. and emerge at 6h. 56m.

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PROCEEDINGS OF LEARNED SOCIETIES.

BY W. B. TEGETMEIER.

GEOLOGICAL SOCIETY.—*Dec.* 17.

NEW GRAPTOLITES IN THE SKIDDAW SLATES.—Professor Harkness and Mr. J. W. Salter communicated a paper in which they stated that they had discovered several species of Graptolites new to the Skiddaw Slates in certain flaggy beds almost devoid of cleavage, which occur at intervals in the lower portion of the series, in several localities. The rocks are much more fossiliferous than has hitherto been supposed; and the evidence of the fossils clearly proves them to be of the same age as the Lower Llandeilo rocks of Wales and the Quebec Group of Canada. The thickness of the Skiddaw Slates was estimated at 7000 feet, and the total thickness from the base of the Skiddaw Slates to the Coniston limestone is 14,000 feet.

Besides several species of well-known Graptolites that are also found in the Lower Llandeilo rocks and in the Quebec Group (Taconic System), Mr. Salter has been enabled to identify *Phyllograpsus angustifolium*, Hall, *Tetragrapsus bryonides*, Hall, and another species of that genus, *Dichograpsus Sedgwicki*. Also a new species, *Didymograpsus caduceus*, and some others. He has given the name of *Caryocaris Wrightii* to a Crustacean discovered in these rocks by Mr. Wright. Mr. Salter considers the Skiddaw Slates to be of the same age as the Quebec Group, the graptolitiferous rocks of Melbourne, and the Tremadoc Slates of Wales.

ROYAL SOCIETY.—*Jan.* 8.

ON THE IMMUNITY OF THE STOMACH FROM BEING DIGESTED.—The fact that the stomach resists during life the action of its own gastric fluid, but that it is readily dissolved by it after death, should that event occur during the process of digestion, is one well known to physiologists.

John Hunter attributed this immunity to the protecting agency of the living principle; but it has been shown, by direct experiment, that the tissues of living animals are dissolved when introduced into the stomach. At present the prevailing idea is that the mucous lining serves as a protection, by being constantly renewed during life.

Dr. Pavy's paper contained a description of some experiments disproving this view, inasmuch as he found that the mucous membrane might be entirely removed from a portion of the stomach, and that food could afterwards be digested without the abraded surface of the stomach presenting the least evidence of having been attacked.

Dr. Pavy suggested that the protection of the stomach was due to chemical principles; inasmuch as the acidity, which is an essential characteristic of the gastric juice, would be prevented acting on the

living tissues by the current of alkaline blood which is always circulating during life; but that after death, the blood being stagnant, there would be no resistance to the penetration of the acid digestive menstruum, consequently the stomach itself would be attacked if death occurred during the continuance of the digestive process. In the discussion which ensued, Dr. Miller observed that as the blood contained in the vessels of the stomach had secreted or discharged the acid digestive fluid, it must be in a much more alkaline condition than the general mass of the blood, a circumstance which would tend to support Dr. Pavy's theory.

Artificial Formation of Benzoic Acid from Aniline.—Dr. Hoffman described a remarkable series of experiments illustrating the artificial formation of benzoic acid from aniline. It is found that when aniline, $C_{12}H_7N$, is passed through a red hot tube it yields a certain proportion of benzo-nitrile, the formula of which is $C_{14}H_5N$; and further, that when this is boiled with potash benzoic acid is formed, which unites with the potash, forming benzoate of that alkali. The changes that take place in these reactions are remarkable as being the converse of those that usually occur in parallel decompositions, where the substances pass from a higher and more complex to a simpler form. Here, on the contrary, we pass from a lower to a higher state, and from a substance containing twelve equivalents of carbon to another which consists of fourteen.

Supposed Artificial Formation of Fibrine from Albumen.—A paper contributed by Mr. R. Hutchinson Smee was read by Mr. Savory on the supposed formation of fibrine from albumen. Fibrine containing a less per centage of carbon than albumen, Mr. Smee conceived that by directing a current of oxygen gas through the latter, a portion of the carbon might be removed by oxidation, and fibrine produced. The experiments showed that certain fibrous lines were produced by the passage of the gas, but there was no evidence adduced to prove that they were identical with fibrine in composition.

ROYAL GEOGRAPHICAL SOCIETY.—*Jan.* 12.

Reversed Ocean Currents.—Mr. J. A. Mann read a paper descriptive of a reversion of the Guiana current which took place in July and August 1862. In the discussion which ensued, Captain Maury, of the American navy, stated the immense importance of these observations, and that he was aware that the Gulf stream between Halifax and Bermuda had been known to run backwards to the south west, retaining at the same time its elevated temperature and other general characteristics.

Physical Condition of the Atlantic Sea Bed.—Dr. G. C. Wallich read a paper on the physical condition of the North Atlantic sea bed as affecting the success of Atlantic telegraphs. Hitherto soundings have only been taken at mean intervals of thirty-two miles, across an area of 1300 miles of sea. Dr. Wallich denied the proofs of a central Atlantic plateau, stating that the spaces between the previous measurements were sufficient to include some of the largest mountain ranges. Thus soundings of 100

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fathoms had been taken within thirty-two miles of one of 1000 fathoms. Dr. Wallich suggested a fresh survey of the Atlantic by two vessels sailing in parallel courses two miles distant, and taking soundings alternately at five miles distance between any two soundings on the same line; this plan would give 640 observations respecting the deep sea bed in the Atlantic, as contrasted with forty-one obtained in the previous survey.

ZOOLOGICAL SOCIETY.—*Jan.* 13.

Mimetic Analogy in Birds.—In a paper descriptive of some new species of birds collected in Bourou, Mr. Wallace called attention to several new cases of mimetic analogy, or the imitation by one species of the plumage of another. In describing these specimens Mr. Wallace maintained, that the numerous cases of imitation that exist were incapable of being accounted for on any supposition except by that which accounts for the variation of species by natural selection; also that this imitation was a protection against the natural enemies of the imitating animal; that those animals most closely resembling the aggressive species were the most certain to escape destruction and perpetuate their variety; and that this method of natural selection acting through long periods produced the close imitation between species in totally distinct genera or orders, which appears capable of explanation on no other hypothesis.

BRISTOL NATURALISTS' SOCIETY.

This society, which was established in May last, is doing much to awaken an interest in scientific pursuits in Bristol. It numbers nearly 200 members, and from 60 to 100 attend its meetings, held the first Thursday in every month. Mr. W. Sanders is the President. In the summer, three excursion meetings were held, and various parts of the country around Bristol visited, chiefly, but not entirely, for geological purposes.

At the October meeting, Dr. W. B. Herapath made a communication, in which he gave a general view of the classification of Echinodermata, and made especial mention of the internal anatomy of *Uraster glacialis* and *Luidia fragilissima*. In a discussion which followed, Mr. W. L. Carpenter observed that he had seen specimens of Ophiocoma, partly digested, extracted from the stomach of a large Luidia. Also that his father, Dr. W. B. Carpenter, had employed *pure* glycerine, with the greatest success, for the preservation of many Asteridæ, and Ophiuridæ and Comatulæ also; the animal being in all cases slightly diminished in size by endosmose, but the colour perfectly preserved.

Mr. W. W. Stoddart, the hon. treasurer, then read a paper on some fossil plant beds of the Isle of Wight, which he had visited in the summer. After describing the beautiful scenery of the western part of the island, the author showed that the sections of the several

ages were very extensive and complete, while their ready access afforded great facility for palæontological study. The hazel-nut sands, Brooke Point, and chara seed beds of Colwell Bay and Headon Hill were first noticed, the latter being found in great abundance at Warden Point, and forming a magnificent object for the binocular microscope. The author remarked that the section at Brooke Point, from which he gathered the hazel-nuts and remains of Coleoptera, showed the bed to be placed *above* the gravel, and not *below*, as described in the Jermyn Street Memoirs. He then gave a short description of the pipeclay bed in Alum Bay, abounding in the leaves of as many as fifty-one species of Phanerogamic plants; pointed out the position of the beds with regard to the underlying Bagshot sands, and showed that, from a remarkable local disturbance, many of the beds had been thrown into a vertical position. The perfect absence of colour in the organic remains of this bed was then noticed, all those in the strata above and below being in the condition of lignite. The leaves were then described and shown to belong to sub-tropical plants, and the locality of the different genera pointed out—representatives of the Cassia, Banyan, and Tamarind trees occurring. The author concluded an interesting paper, illustrated by numerous specimens and diagrams, by drawing some deductions as to the probable climate of England during the deposition of these beds.

At the November meeting, Dr. Beddoe made some observations on the physical characteristics of the natives of the neighbouring districts. He compared them with respect to stature and bulk with the inhabitants of several other parts of Great Britain and Ireland, a number of measurements having been taken in conjunction with, or at the instigation of, Dr. Barnard Davis, one of the learned authors of *Crania Britannica*. The result of this comparison was, that the average stature of Bristolians was rather below that of the natives of the nearest rural districts, and considerably below the average of Scotland generally, and of Cornwall. The form and dimensions of the head differed little, but the author was of opinion that a judicious system of measurement would bring out more decided local or ethnological differences, and he instanced the more or less backward position of the greatest transverse diameter as a diagnostic between the Saxon and the so-called Celtic race. From evidence derived from 2500 observations, he showed that the colour of the hair was more frequently dark in Somerset and the west than in Gloucestershire or Wiltshire; Bristol men occupying an intermediate position, together with natives of the towns in Somerset. While protesting against the popular idea that the Celt, as compared with the Saxon, shows pretty uniformly great physical inferiority, Dr. Beddoe yet considered that many of the above facts could be best explained by ascribing them to ethnological causes. Wiltshire and Gloucestershire were conquered and colonized by the Saxons long before Somerset and Dorset, and subsequent immigration from the East would take place principally into the towns. The great frequency of narrow chins and prominent cheek-bones in the peasantry of Somerset might be accounted for by the predominance, up

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to our own times, of Celtic blood. The author concluded by urging the desirability of bringing out and recording these local peculiarities before the increased facilities for migration and counter-migration afforded by railways, etc., obliterated them.

Mr. W. W. Stoddart then made some remarks on the employment of the Spanish Esparto grass, *Stipa tenacissima*, as a substitute for rags in the manufacture of paper, illustrating them with a complete series of specimens from Messrs. Somerville, of Bitton.

At the December meeting, Mr. Leipner, the hon. secretary, read a paper on textile vegetable fibres, with particular reference to *Zostera marina*, the proposed substitute for cotton. He commenced by observing that all textile fibres were derived either from the vascular or cellular tissue in plants, and that the first class of these was the most abundant. From the bark of perennial exogens were obtained bass (from a lime-tree), jute, Indian fibre, etc. In annual exogens, where the vascular tissue formed a small portion only of the stem, the whole stalk was used. To plants belonging to this class we owed all the hemps, flax, Chinese grass, Rhea fibre, etc. From endogens were derived New Zealand flax, Manilla hemp, Palmetta, and other similar fibres. The *only* example of textile fibres from the cellular tissue of plants was cotton, and for this reason the author did not expect that a *true* substitute for cotton would ever be found, all fibres hitherto proposed being obtained from vascular tissue, which conducted heat more rapidly than cellular tissue, and hence fabrics made from them were neither so soft nor so warm as those manufactured from cotton. In reference to the relative tenacity of various fibres, the author observed that, generally speaking, perennial plants furnished a far less tenacious fibre than annual plants, and also that the more tenacious fibres seemed to be produced by the most rapidly-growing plants. He then proceeded to speak more in detail of *Z. marina*, and concluded an interesting and well-illustrated paper by observing that the greatest obstacle to its use was the difficulty of collecting.

Mr. W. L. Carpenter then gave an exposition of Professor Graham's researches in Dialysis, specially explaining its varied applications, and illustrating his subject by experiments; but as an account of Dialysis has already appeared in our pages, we abstain from reporting this paper.

Mr. Leipner then communicated some notes on the natural history of a land-tortoise, from which it appeared that on July 25th, 1862, a female tortoise, which had been for upwards of fifty years in the possession of the family of Mrs. Williams, of Tregallon Scorrier, Cornwall, had laid some eggs, which were hatched in a pine pit at a temperature ranging from 70° to 85°. The male tortoise was obtained about four years ago, so that in the case of the female there had been a complete suspension of the generative functions for fifty years.

W. Lant Carpenter.

LITERARY NOTICES.

We have received many publications which we have not had an opportunity of noticing in a more extended form; among them are the following:—

Livingstone's Travels and Researches in South Africa, new edition, 8vo (Murray), placing this interesting work within reach of numerous readers, to whom the original and more expensive form was inaccessible.

Eccentric and Centric Force, a New Theory of Projection. By Henry F. Pratt, M.D. (Churchill).—The author of this work erroneously imagines that he can overthrow the foundations of astronomical science, and substitute a theory which he conceives more consistent with the glory of the Creator.

In quite another spirit the Rev. W. N. Molesworth, Incumbent of St. Clement's, Rochdale, contributes to popular education.

Plain Lectures on Astronomy (Ireland, Manchester; Simpkin, London). They are written in a singularly clear and interesting style, which proves their author to possess no ordinary power of presenting a difficult subject in an intelligible form. They have also the advantages of good print and low price.

A Lecture on the History of the Law of Gravitation, by Thomas William Burr, F.R.C.S. (Clement's, London), is also a good specimen of luminous explanation.

Observational Astronomy, Edited by Jas. T. Slugg, consists of cheap and handy diagrams, accompanied by explanatory letter-press, to assist amateurs in finding interesting objects amongst the various constellations.

Bird Murder (Wertheim), by a Country Clergyman, is an excellent tract against the cruel and mischievous destruction of the feathered inhabitants of our gardens and fields.

The Circle Secerned from the Square, by William Hamilton (Simpkin), is, as its name imparts, a mathematical paper.

Underground London, post 8vo, is the title of an agreeable work by Mr. Hollingshead, who cleverly sketches the numerous wonders of the subterranean regions of our metropolis.

The Year-Book of Facts and the Industry, Science, and Art of the Age, both by John Timbs, fcap. 8vo (Lockwood), manifest this veteran author's customary care as an indefatigable compiler. The last named is an excellent memorial of the Great Exhibition of last year, and has for a frontispiece an admirable photograph of the nave of the huge building and its multifarious contents.

Brambles and Bay Leaves, 8vo, is the second edition of Essays on Things Homely and Beautiful, by Shirley Hibberd, and is characterized by the intense love of nature and grace of expression for which its author is renowned. It is an elegant work for a present, or a prize in a first-class school.

Science Elucidative of Scripture and not Antagonistic to it, by John Radford Young, formerly Professor of Mathematics in

Belfast College, fcap. 8vo (Lockwood), is a controversial work battling with "Essays and Reviews," "Bishop Colenso," and the critical school.

To the above we may add sundry numbers of the QUARTERLY JOURNAL OF THE MICROSCOPIC SOCIETY, containing a variety of information and many admirable plates; and likewise of the EDINBURGH VETERINARY REVIEW, of special interest to those whose avocations connect them with live stock.

NOTES AND MEMORANDA.

FOWLS WITH BLACK PERIOSTEUM.—Mr. G. H. Inskip, Master in the Royal Navy, sends us the following: "Seeing, as if a thing of rare occurrence, in the "Notes and Memoranda" of the INTELLECTUAL OBSERVER for January of this year, some remarks on a Cochin China fowl with black periosteum, let me state that we frequently found, while employed surveying in the Gulf of Siam, the common fowls, purchased at Bangkok and along the coast, to have apparently black bones, with dark flesh, looking as if saturated with pale black ink. We preferred eating the fowls not so discoloured, more on account of their appearance than from any marked difference in their flavour."

PILLISCHER'S NEW MICROSCOPE AND LAMP.—We have carefully examined the instrument which Mr. Pillischer designates the "New £5 Prize Microscope," and find its merits of a very high order. Those who can spare the money will, of course, prefer a higher-priced and more perfect construction, but this pattern supplies all that is really necessary for the instruction of the student or the gratification of a family sufficiently intelligent to devote its evenings to rational pursuits. The new Microscope is distinguished from other educational instruments by possessing a very simple and ingenious mechanical stage, and by having a dividing object-glass, constructed upon optical principles very superior to those of the ordinary French and German combinations. The stage movement is founded upon the action of the elbow joint and shoulder of the human arm. On the left-hand upper corner of the stage is a pivot, on which a brass arm moves. This arm is continued down the left-hand side of the stage, and is connected with the object-holder by an elbow joint. By applying the thumb and finger to a projecting pin with which the object-holder is furnished, and steadying the hand against the stage, a variety of movements may be obtained in horizontal and vertical directions, and every part of a large object successively brought into the centre of the field. The peculiarity of the object-glass consists in such an arrangement of lenses and stops, that the quarter-inch may be reduced to half-an-inch, and that again to an inch, without any practical deterioration of performance. The quarter-inch shows the *Pleurosigma hippocampus* beautifully, and works well on a Podura scale. The half-inch has a flat field and excellent definition. Several which we examined stood tests that we scarcely thought it fair to apply, and the one-inch is a thoroughly good working power. No dividing combinations can possibly equal separate objectives, worth four times their price; but Mr. Pillischer has so successfully minimized the evils of this system, as to meet the requirements of the majority of microscopic students.

Mr. Pillischer's lamps are of very elegant construction. From the position of the reservoir they throw no shadow. When used for the microscope, they have a shade which admirably imitates the favourite "white cloud illumination," and when employed as reading lamps this may give place to a shade of similar shape, which throws a white light on the book, and offers a pleasant, cool, green surface to the eye. The chimney is either of common glass, or with a bluish tint. The latter so completely corrects the slight yellowness of the flame as to permit blue and green to be readily distinguished, and colour-top experiments to be performed almost as well as in broad day.

ILLUMINATING SHELLS.—M. France, a lieutenant of artillery, says *Cosmos*, has invented a shell which illuminates an area of several hundred yards. Three or four of them are found sufficient to light up an extensive plain.

THE AURORA OF DECEMBER.—The splendid Aurora of the 15th of last month was well seen at Marseilles and in Northern Italy. At Puycharnaud (Dordogne) soon after sunset, a writer in *Cosmos* describes the sky as of a brilliant gold tint. At 5·20 p.m. this disappeared, and was followed by a luminous rose-coloured cloud, which enveloped the three conspicuous stars of the Great Bear's tail. A quarter of an hour later a similar cloud formed towards the east, and then both disappeared. They were immediately replaced by three spots of silvery or greenish white, one in the magnetic meridian, and one on each side of it about 15° above the horizon. In a few minutes afterwards numerous streaks of light radiated from these centres, gleaming with white, purple, and rose. The changes were rapid, and usually ended in pale or shaded green. This stage of the aurora lasted about twenty-five minutes, and was followed by a period of repose, but the whole northern sky was illuminated. At nine the corruscations began again with still greater splendour of tint and variety of form. At nine and three-quarters came another calm, and the arc which had been the scene of the brilliant effects assumed the aspect of a lake of molten silver. This appearance diminished, and seemed over by eleven. At 11·20 a fresh column of light appeared, and new splendours were exhibited. A little before midnight a few flashes were seen over the horizon, but the moonlight caused them to disappear. When the aurora was at its height at 6·50 p.m. a globe of white light twice the apparent size of Venus made its appearance near the pole, and moved slowly towards the horizon from south-east to north-west. A similar globe was seen about half-past eleven. The display lasted for six hours and a-half, during which the compass-needle was in continuous agitation.

PHILOSOPHY OF WINDS.—Mr. Thomas Hopkins, M.B.M.S., recently read a paper before the Manchester Literary and Philosophical Society to show "that air going from certain slowly revolving polar localities to others that revolve more swiftly, is not left behind in the way that is generally supposed." He states that on the east side of the Atlantic, in the Gulf of Guinea, air passes towards the east, not only without being left behind, but with additional speed," and that "in like manner winds blow on the eastern side of the Pacific within both northern and southern tropics, and must, therefore, rotate eastward more swiftly than the surface on which the air presses. It was contended that the cause which determined the air constituting these winds to rotate faster than the surface of the globe that was beneath them, ought to be considered that which makes other winds pass over the surface when they do not move with equal rotatory velocity, and were, therefore, said to be left behind." He considers that the atmosphere presses on the surface of the globe with a force that causes the air to move with the surface in its rotation, unless its own uniformity of pressure is disturbed.

A LUMINOUS NIGHT.—Mr. Baxendell, F.R.A.S., communicated to the same society the singular fact that on the night of the 24th October, 1862, although there was no moon, nor visible aurora, there was for two hours enough light in the air to allow buildings and hedgerows to be distinctly seen in the country round Mr. Worthington's observatory.

MICROSCOPIC USE OF MAGENTA DYE.—Dr. Roberts pointed out to the microscopic section of the same body the advantage of employing the Magenta dye to tinge blood globules or animal cells. It causes nuclear structures to be distinctly displayed.

WHITE SUBSTANCES.—In "Some Remarks on Light" read before the Microscopical Society of Newcastle-upon-Tyne, Mr. B. S. Proctor observes, "Precipitated chalk far outshines the natural varieties, and fine qualities of carbonate of magnesia outshine it. Of a great number of substances I have compared, Howard's carbonate of magnesia is the whitest, and microscopical examination indicates that it consists of clear, colourless particles, but very minute."

MICROSCOPIC EXHIBITION OF STARCH.—In the same paper Mr. Proctor observes, "I have here three mountings of tous-les-mois ..... you will observe that which is in balsam has a dark centre while it is beyond focus, is uniformly light at

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focus, and has a bright centre when within focus, indicating that the balsam has a higher refracting power than the granules; with that mounted in the gelatinous medium, you will find the effects of increasing and diminishing the distance from the object-glass are reversed, indicating that the starch has now a refracting power above that of the medium in which it is enveloped, and the markings on its surface are in this mounting much more distinct."

IODINE AND SULPHUR.—M. Diethenbacher states that if one four-hundredth part of iodine is added to sulphur heated to about 180° C (356° F.), and the mixture poured on a slab of porcelain, there results a sheet of the material which is easily detached, and which retains for several hours, and even for several days, a remarkable elasticity. It possesses a metallic lustre, and takes impressions with great fidelity.—*Comptes Rendus.*

PECULIARITIES OF THALLIUM.—The commission on Thallium appointed by the French Academy, remark that its discovery forms an epoch in the history of chemistry, on account of the astonishing contrast between its chemical and physical characters—they call it the "ornithorynchus of metals." It has nearly the same appearance as lead, may be cut in a similar manner, and leaves a similar trace on paper. It has, moreover, the same density, nearly the same fusing point, and the same specific heat. Its solutions, like those of lead, yield a black precipitate with sulphuretted hydrogen, a yellow one with iodides and chromates, and a white one with chlorides. But it indubitably belongs to the family of alkaline metals, which recent discoveries have doubled in number. In this list Thallium stands, as regards the weight of its equivalent, at the opposite extremity of the scale to Lithium, the numbers being, Lithium, 7; Sodium, 23; Potassium, 39; Rubidium, 85; Cœsium, 120; Thallium, 204. The Commission remark that the equivalent of Sodium is exactly the mean between that of Potassium and Lithium; that if double the atomic weight of Sodium is added to that of Potassium, the equivalent of Rubidium is obtained; that adding double the weight of Sodium to double that of Potassium, gives very nearly that of Cœsium; and that adding double the weight of Sodium to four times the weight of Potassium, gives nearly that of Thallium. The equivalents of all the alkaline metals, Thallium included, must be halved to make them fit Dulong and Petit's law concerning the relation of atomic weight to specific heat. The Commissioners further observe that the alkaline metal series contains one, Lithium, whose atomic weight is so light as to place it near hydrogen, and another, Thallium, so heavy as to rank with Bismuth, whose equivalent is the heaviest known.—*Comptes Rendus, 15th December*, 1862.

CORYMORPHA NUTANS.—Professor Allman, in "Notes on the Hydroida," communicated to the *Annals of Natural History*, states that, as Edward Forbes suspected, the medusoid of the Corymorpha nutans belongs to the form described by that naturalist as Steenstrupia. Besides the production of medusoid sexual buds, he observed another mode of reproduction, the exact significance of which he was unable to ascertain. It consisted in the formation of minute oblong bodies, which developed a small polyp at one extremity. He considered them to arise from gemmation, and thrown off by adult specimens in some way unknown.

MAGNETISM, ELECTRICITY, AND VEGETATION.—In his *Physique du Globe* M. Quetelet tells us that on examining attentively the value of the monthly magnetic variation, it is found to be in direct relation with the force of vegetation. When the latter sleeps, which happens in the months of November, December, January, and February, the magnetic variation, at Brussels, is almost uniformly 5′ 28″, or scarcely half during the period of its full activity, that is to say, from April to September, when its mean is 10′ 15″. It reaches its plenitude in April, when the mean is 11′ 14″, for Brussels. In another passage, M. Quetelet states, that the electricity of the air is intimately connected with the action of vegetation, and that the two phenomena have a nearly parallel march. It is not pretended that one depends on the other, but that both arise from the same cause. The quantity of atmospheric electricity at noon is much greater in winter than in summer, the relation being about 10 to 1. This augmentation of electric force proceeds in a manner almost parallel with the number of days of frost and fog, and inversely as the number of days of thunder, of elevation of temperature, of actinic power.